

JUNE  
1936

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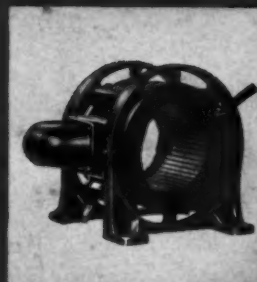
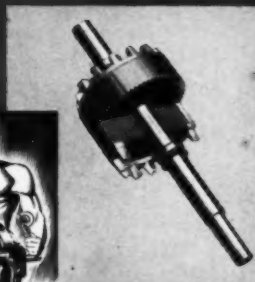
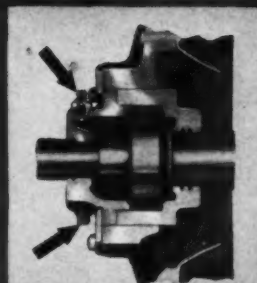
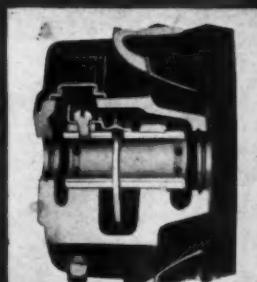
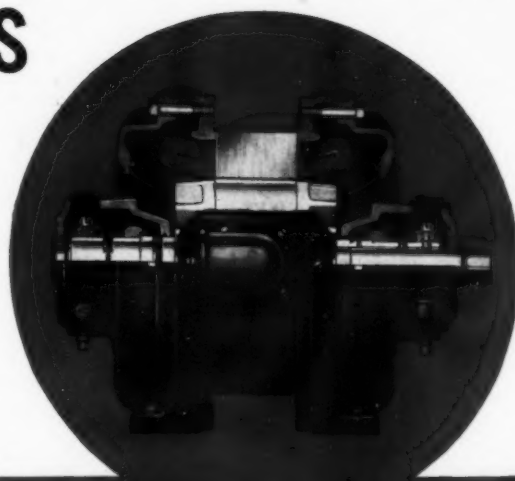
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# GENERAL ELECTRIC

020-264

Turn to pages 79 to 96 inclusive for General Electric Master Electrical Wiring Material and Equipment



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## C O N T E N T S

Vol. 35 JUNE - 1936 No. 8

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*in twelve parts*

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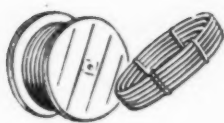
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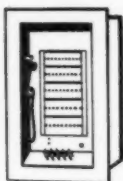
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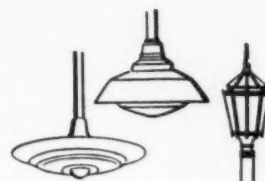
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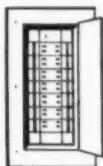
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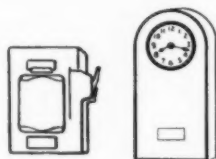
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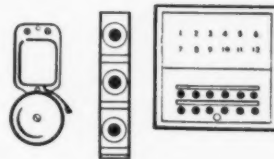
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## A MASTER SPECIFICATION

*and design procedure for the adequate  
wiring of all classes of occupancy*

**I**N THE succeeding pages there is presented a comprehensive Master Electrical Specification covering adequate wiring for any regularly used electrical service in any building. To make this Master Electrical Specification of maximum use to contractors, engineers and architects it is supplemented by the following:

1. A recommended procedure for wiring design together with the symbols and engineering tables needed to make the essential wiring plans and layouts.
2. A series of five Checking Charts which will serve as fairly complete reminder lists of electrical services and equipments to which consideration must be given when planning the wiring in order that nothing essential will be omitted.
3. Standards on which adequate wiring provisions are based.
4. Schematic diagrams of the essential elements of every wiring installation as well as the electrical services for which the wiring is designed, these to serve as a guide to the designer in making his layouts.

Wherever official industry standards have been available they have been incorporated. Where no such standards

have been available, commonly accepted good practice has been used as the basis.

In the preparation of this Master Electrical Specification every effort was made to give the user, without any suggestion of preference, the information he would need to make his own selection of materials, equipments and wiring methods. Detailed functional and dimensional data on materials and equipments will be found in the accompanying advertisements.

This is probably the most ambitious project we have ever undertaken, involving as it does the bringing together for the first time all of the elements of wiring design and specification for all classes of electric service in every type of building, and the condensation into one practical volume without the loss of any essential information of all the ramifications of these elements.

ELECTRICAL CONTRACTING presents this Master Electrical Specification to the designers of electrical wiring installations and to the entire electrical industry with the hope that it will be instrumental in greatly improving the wiring plans, layouts and specifications to the end that the customer is better served through a more adequate electrical installation, that bidding competition is improved, and that the practice of gambling on extras is reduced.

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## Design Procedure

### 101. Building Plans:

A complete set of building plans, always including a sectional elevation showing floor heights, should be available when the wiring layout is to be prepared. These plans should provide complete data with respect to construction of floors, outside walls, inside walls and partitions, suspended ceilings, and panelled work or other special finish requiring exact location of outlets.

### 102. Wiring Plans:

102.1. When the building plans are not too complex, and not too densely traced with structural details, all electrical outlets and wiring may be indicated thereon. A separate tracing of each floor devoid of details not essential to the electrical work is recommended for the preparation of most wiring plans. A feeder or "riser" diagram should also be made where there are three or more feeders. These riser diagrams may include schematic explanations of special systems, such as private intercommunicating telephones, stairway controls, remote-controlled motor details, etc.

102.2. The wiring plans, and general plans as well, should show at their locations all outlets, switches, motors, controllers, auxiliary electrical equipments, panelboards, service equipment, and such special system outlets as signals, telephones, clocks, exit lights, etc. Standard symbols will be found in Part 10, Engineering Data. The wiring plans should show the completed wiring details which are in most cases too complex to indicate clearly upon detailed structural plans.

### 103. Layout Procedure:

The steps to follow in preparing the wiring plans are:

103.1. *Initial space provisions:* Obtain tentative location and type of service, especially if current is to be supplied by the power company, based on the approximate demand for the building. Assign liberal spaces and clearances to accommodate service raceways, service equipment, transformer station, and main distribution center. Final details can be determined only after the layout is completed and the load has been computed.

103.2. *Lighting layouts:* Locate and mark by standard symbol all (1) lighting outlets, (2) convenience, appliance, heavy-duty or other special outlets, (3) local or multi-location switch controls (trace in to outlets they control), (4) lighting panelboards. Determine circuit distribution, interconnect outlets, and assign circuit numbers. Where the wire is larger than No. 12, show the size, the number of wires per run, and the size of raceway to be used.

103.3. *Power layouts:* Locate and mark by standard symbol all (1) motors, (2) controllers, (3) stationary heating devices, (4) remote control and auxiliary control devices, (5) power panelboards. Determine branch circuit distribution, wire and raceway size, and assign circuit numbers.

Where any considerable number of motors is to be wired for the location of each motor and other power equipment, such as heaters, should be shown on the plans, also showing the hp. or k.w. rating, the kind of machine driven and the location of the controller. It is well to assign a number to each motor and to prepare specification sheets giving

for each motor or heater its number, location, hp. or k.w. rating, description of machine driven and type of controller to be used.

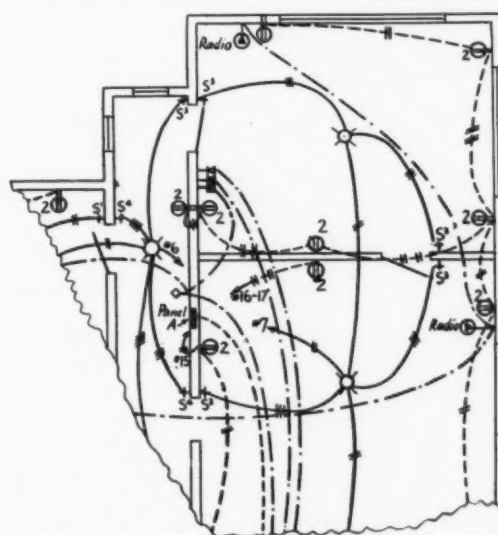
103.4. *Auxiliary system layouts:* Locate and mark by standard symbol, all (1) auxiliary system outlets, such as telephones, gongs, annunciators, etc., (2) junction or terminal cabinets, (3) batteries, transformers, or other power supply sources. Determine circuit routing or subdivision, indicate on plans and riser diagram, and provide for panelboard circuits to supply auxiliary systems.

103.5. *Circuit runs:* For concealed work in fireproof construction, circuit runs should as far as possible be shown as straight lines from outlet to outlet. For concealed raceway work in wood joist construction, right angle bends must as a rule be used and it is preferable to lay out the work in such manner as to indicate such bends on the wiring plan. For exposed work the approximate actual position of the runs should be shown.

103.6. *Abusive or hazardous area design:* Isolate or place in a separate room wherever possible all equipment the safe or successful operation of which would be affected by (1) abrasive metals, dusts and chips, (2) condensation, (3) corrosive atmospheres, (4) excessive temperatures, (5) grease and oil, (6) excessive vibration, (7) water drippage or splashing, (8) explosive dusts or fumes, (9) ignitable fibres, flyings or accumulations, (10) flood waters. Provide sealing fittings in raceways leading to rooms of widely different temperatures, to prevent air circulation and condensation within such raceways.

103.7. *Final calculations:* Calculate, route and indicate on plans and riser diagram the complete feeder system, main distribution equipment, and service equipment.

103.8. *Tracing methods:* In addition to using standard wiring symbols (Part 10), the wiring plan tracings will



SAMPLE WIRING PLAN SHOWING OUTLET SYMBOLS & CIRCUITING METHODS  
No Scale

be more easily checked in the office during the progress of design, during construction, or in case of revisions, by employing various colors of tracing ink to distinguish between lighting, power, signal, telephone, fire alarm or other special systems.

#### 104. Wiring Standards, Recommendations and Reference Data:

To prepare complete wiring layouts, various standards, recommendations, or engineering data, are needed for determining loads, number of outlets, controls, or routing of circuits. The Reference Table (Page 6) provides a quick means for locating necessary data applying to the occupancy under consideration.

#### 105. Lighting Outlets and Outlet Loads:

105.1. In many cases, particularly in industrial plants, either the various classes of work to be done have not been assigned to definite spaces in the building when the wiring layout is made, or there is a probability that at some future time machines and other equipment will be relocated. In all such cases, wiring capacity should be provided that will be sufficient for the maximum probable need.

105.2. The first step in laying out a wiring system is to determine the outlet locations and loads.

105.2.1. *Ceiling outlets for general lighting:* Rules as are given for locating outlets in commercial (Section 301 of Standards) and industrial occupancies (Section 302) apply only to interiors of simple architectural design.

As the architectural features of the room or space become more important, the choice in the location of outlets becomes more and more restricted. Extreme cases are churches, theatres and similar buildings of somewhat elaborate architectural treatment, where the lighting equipment, whether concealed or exposed, must be located so as to fit properly in its surroundings, otherwise the effect is crude and displeasing. Similar conditions may be met in some retail stores, hotel and office building lobbies, lodge halls, libraries, banking rooms, etc. At least a preliminary design of the lighting system should be made in these cases before the wiring is laid out.

Any space that is to be occupied as an office in an industrial building is to be treated as an office, while a workshop in a commercial building is to be treated as an industrial occupancy.

To determine the wattage leads after the outlets have been located, take the watts per square foot required, for the given case (from Tables 2 and 3, Section 304 of the Standards) multiply this figure by the total area of the space, in square feet, to find total watts. This result divided by the total number of outlets gives the computed watts per outlet.

Example: A retail store sales room measures 45 ft. by 96 ft. and there are eighteen ceiling outlets. Single-lamp fixtures are to be installed. What is the proper wattage per outlet? From Table 2, Section 304, the standard load is 4 watts per sq. ft.

45 by 96	=	4320 sq. ft. total area
4,320 by 4 watts	=	17,280 watts
17,280 watts	=	960 watts per outlet
18		

This wattage should then be adjusted to 1000, this being the nearest commercial lamp rating.

In those cases where an illumination system has been designed and specified to produce values of illumination intensity lower than the maximum values referred to above, the wiring layout nevertheless should be based upon the standard, lighting load tables.

If no occupancy corresponding to the given case is listed in either of the tables, a preliminary illumination

design will determine the required watts per outlet.

105.2.2. *Convenience outlets:* In retail stores the use for which convenience outlets are intended should be carefully considered. The general recommendation is not over six outlets per circuit but in many cases this number should be reduced. Only one outlet per circuit may be desirable in certain cases.

105.2.3. *Show window and show case outlets:* Outlets for show window lighting should usually be located on the sides of the columns, at or near the height at which the lighting equipment is to be located.

Floor outlets for show case lighting should be located from final plans showing the exact locations of the store fixtures. In a small store having an unfinished basement, circuits may be carried down from the cabinet to a junction box in the basement. These circuits may be run to the desired locations after the fixture locations have been determined.

Outlets for wall case lighting can usually be located in the wall so as to be just above the cases. Wiring can then be extended on the tops of the cases to the lighting equipment. Where display cases back of the counters and on the column lines are to be lighted, outlets may be located on the columns just above the cases, or if this is not feasible, floor outlets must be provided.

#### 106. Lighting Branch Circuits:

Having determined the outlet location and the watts per outlet, or outlets per circuit, the number of branch circuits should next be determined. It is preferable to make a final check by laying out the circuits on the floor plans. Note that the number of circuits for general illumination is determined from the outlet wattage, Section 305.1. of the Standards, and (for 15-amp. circuits) the limit is 1000 watts per circuit. Refer to Section 306 for convenience outlets; and to Section 305 show window and show case lighting, because other methods are used for determining the number of such branch circuits.

106.1. *Heavy-duty lamp branch circuits.* Where the entire load on a circuit consists of mogul-base lamps or mercury-vapor lamps, special high capacity circuits may be used. These are known as "heavy-duty lamp circuits." These circuits may consist of No. 12, No. 10, No. 8 or No. 6 wire, with overcurrent protective devices rated or set at 20 amp., 25 amp., 35 amp., or 40 amp., respectively.

106.1.1. For mogul-base incandescent lamps, these high capacity circuits should be so laid out that the initial load may be increased by substituting lamps of the next larger size. Circuits of No. 12 wire need not be considered because with this size the voltage drop would be excessive unless the circuits are very short. For circuits of larger wire the initial loading should not exceed 1500 watts for No. 10, nor 3000 watts for No. 8 or No. 6.

106.1.2. The Standards Section 305.1., provide that the initial load on a 15-amp. circuit shall not exceed 1000 watts, hence for any higher wattage it is necessary to use heavy-duty circuits if single-lamp fixtures are to be used. Thus if each bay measures 18 ft. by 20 ft. and 4 watts per sq. ft. is required, with one outlet in the center of each bay, the wattage per outlet is  $360 \times 4 = 1440$  watts. For single-lamp fixtures a heavy-duty circuit of No. 10 wire or larger should be run to each outlet, or No. 8 or No. 6 wire may be used with two outlets per circuit.

106.2. *Voltage drop.* The voltage drop on lighting branch circuits should preferably not exceed 2 per cent. It is not practical to calculate the wire size for every circuit, because too much time would be required to make the calculations, and in order to avoid unnecessary complication it is better to use not more than two sizes of wire.

A sufficiently close approximation to the desired voltage



drop will be obtained by following the rules for wire sizes and voltage drop (Section 305.4).

**106.3. Heavy-duty lamp circuits.** In the case of heavy-duty lamp branch circuits, so many different circuit layouts are possible that it is hardly practicable to lay down any general rules for determining wire sizes. The following table covers some typical cases, based upon the assumption that all outlets supplied by one circuit are in a single row, with the home run feeding to an end outlet, and that the distance between any two adjacent outlets is 20 ft. The lamp wattage specified is in each case the "initial" load and lamps one size larger may be substituted without seriously exceeding 2 per cent voltage drop.

**HEAVY-DUTY LAMP CIRCUITS—WIRE SIZES**

Outlets in a single row—home run to an end outlet

Circuit Capacity Amp.	No. Lamps and Wattage	Distance to 1st Outlet Feet	Size Wire to 1st Outlet	Gage No. Remainder of Circuit
25	2-750	0-60	10	10
		60-100	8	10
25	3-500	0-40	10	10
		40-70	8	10
35	4-750	0-25	8	8
		25-50	6	6
35	2-1000	0-60	8	8
		60-100	6	8

### 107. Motor and Heating Device Outlets

The size and type of motor or heating device to be indicated on the plans is nearly always determined by specific units of mechanical equipment. Therefore, the discussion with respect to design procedure for power wiring must be based on the assumption that such equipment has been definitely selected before wiring plans are prepared.

**107.1. Outlet Locations.** In most cases the location of machinery such as pumps, compressors, elevators, blowers, etc., is fixed because of structural or other important mechanical design features. Therefore, the motor or heating device location is largely dictated by the machinery location.

**107.2. Controller Locations.** Particular care must be given to locate control equipment for maximum accessibility, to save steps, and to isolate it from mechanical injury or deterioration from dripping water, vapors, etc. To meet one or more of these conditions often necessitates a carefully chosen controller location at a remote out-of-danger place. Therefore one or more remote-control push button stations are usually located nearby or upon each machine. In addition various auxiliary combinations of limiting switches or tripping devices may be selected or may already be included as integral machine equipment. The wiring plans should indicate clearly the locations of such controlling devices and the raceway routings to be followed when wiring connections are not already provided for them on the machine.

**107.2.1.** In grouping at one location two or more assemblies of controllers, disconnecting switches, resistors, and other auxiliary devices, show on wiring plans such details as are necessary to assure the fabrication of supporting frameworks and the proper alignment or positioning of raceways to meet exacting requirements.

**107.2.2.** To determine the detailed requirements for motor controllers and their disconnecting means see Article 10 of the National Electrical Code. Where a motor controller is not located within sight of its motor, the controller must usually be capable of being locked in the open position. A manually operable switch designed to prevent

the starting of a motor may be located within sight of remote-controlled motors. This switch may be placed in the remote-control circuit of the remote-control switch or switches, or it may disconnect the motor branch circuit conductors.

**107.3. Branch Circuits.** Wiring connections should indicate (1) whether raceways are to be run concealed or exposed between the motor or heating device and its control equipment, (2) whether run overhead or on the floor, and (3) the exact location for terminating the raceway beside the motor.

**107.3.1.** Many motors and heating devices, as for printing press and laundry equipment, are mounted on machines with or without machine-mounted controllers. For such cases, particularly in concealed home-runs, the wiring plans should indicate the exact raceway termination at each machine. When a machine is supplied with all its wiring installed by the manufacturer, state this condition, whereas the complete details of all wiring that is to be attached to machines by the wiring contractor should be indicated on the wiring plans.

**107.3.2.** For motors or heating devices that are located in areas having floors subject to seepage or prevalent moisture, the raceways may in some cases be routed overhead to avoid traps or water pockets.

### 108. Auxiliary System Outlets

(For telephones, annunciators, alarms, public address, emergency lighting, etc.) (See Part 8, for system details.)

**108.1. Outlet and Equipment Location.** The wiring plans must show outlet locations for exit and emergency lights to comply with the National Electrical Code, state and local fire or safety regulations. The locations of equipment for non-compulsory systems such as annunciators, loudspeakers, etc., should be chosen for ready access, step-saving, audibility or visibility. Transformers, charging devices, master instruments, relay panels, and junction or distributing cabinets should be located to permit easy access for maintenance.

**108.2.** Circuit routings should be shown on wiring plans to indicate outlet inter-connection. If future extensions to the system are contemplated, the careful routing and termination of initial circuits will greatly simplify such work later on. Unless circuit or cable runs are clearly determined on the wiring plans, frequent tap-offs or multi-cable splices may be attempted which would tend to complicate maintenance of the system.

**108.3.** To simplify the routing and identification of auxiliary system conductors or cables, junction or terminal cabinets should be located at accessible points.

**108.4.** All branch circuits that supply power to auxiliary systems, such as for signalling transformers, battery chargers, converters, or for synchronous clock systems should be clearly identified within the panelboard to prevent them becoming disconnected by mistake. This is most likely to occur at panelboards from which groups of lights are turned on and off by various persons. The levers of such special circuit switches may be omitted, locked or of the key-insert type, or these switches placed in a sectional locked panelboard door.

### 109. Lighting Panelboards

**109.1.** The simplest form of panelboard is that providing one fuse for each ungrounded circuit conductor, or, for the ordinary two-wire circuit, one fuse per circuit. For circuits operating at not over 125 volts, plug fuses are generally preferred to cartridge fuses as being easier to replace, less expensive and occupying less space.

**109.2.** Branch-circuit switch control at the panelboard is commonly provided in retail stores and in large spaces where it

is convenient to have a single point of control, except where a more elaborate control system is called for, as in a theatre or other assembly hall. In an apartment building, hospital, or school building, local control by means of wall switches is necessary and circuit switches on panelboards are desirable but are not required. Circuit switches on panelboards are usually single-pole and of 30-amp. rating.

109.3. Branch-circuit circuit breakers may be substituted for switches and fuses and, when used, provide both overcurrent protection and individual circuit control.

109.4. If any heavy-duty circuits are to be used and if the load per circuit would exceed 30 amp. after replacing the original lamps with lamps one size larger, the panelboards must be specially equipped for the protection of these high-wattage circuits.

109.5. Panelboards can be obtained with main fuses or a main circuit breaker. Such equipment is usually the most practical means of providing overcurrent protection for a panelboard where such protection is required. A main switch or circuit breaker may be useful if all circuits are to be controlled together; for example, a panelboard supplying show window lighting only.

109.6. Spare circuit equipment, as called for on Section 308, Standards, should be provided on every panelboard amounting to at least one spare circuit for each five circuits utilized in the original layout. Where the cabinet is built into the wall, provisions should be made for bringing this number of circuits out of the cabinet without channelling the finished wall. Such provision may consist of empty raceways run up from the cabinet to covered outlet boxes located in the ceiling, or run down to boxes in the ceiling of the story below, or both; or by leaving space for two additional wires in each run from the panelboard to the first outlet.

109.7. Each of the following considerations shall be given due weight in determining the required number of panelboards and their location:

109.7.1. Good practice limits the number of branch circuits distributed from one location or panel to a maximum of 42.

109.7.2. No branch circuit run from the cabinet to the first outlet should exceed 100 ft.

109.7.3. Panelboards should always be accessible for the replacement of fuses or the resetting of circuit breakers. If circuit switches or circuit breakers are to be used for the control of lighting equipment, convenience of access for this purpose should also be considered.

109.7.4. Panelboard locations should be so chosen that the feeders will be as short as possible and may be brought to the panels with a minimum of expense for bends and offsets. It is difficult and often impossible to install large conduits concealed in the floor construction.

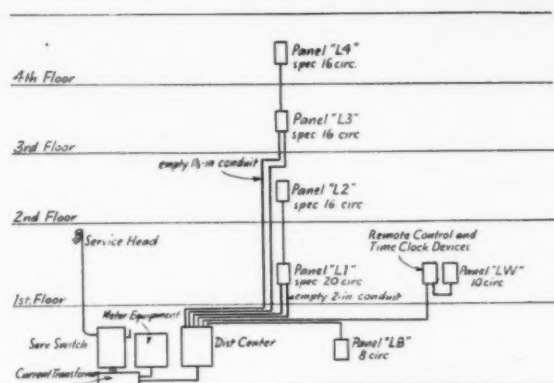
109.7.5. In a small building consisting of one story and a basement, a single panelboard located on the main floor may be sufficient. For larger buildings, one panelboard per floor may be considered the minimum.

## 110. Power Panelboards

The system of wiring for motors and heating devices usually comprises a combination of sub-feeders and branch circuits. For this reason power panelboards are usually designed as recommended in Section 113 for Feeder Distribution Centers.

## 111. Lighting Feeders

111.1. *Carrying capacity:* The minimum sizes of feeders to provide for carrying capacity are to be based upon a load of 1,000 watts for each 15-amp. branch circuit installed, plus the total initial wattage of all heavy-duty lamp circuits, plus 500 watts for each spare circuit provided on the panelboard.



**Lighting Feeder System Riser Diagram**  
Insert Schedule of Raceway and Wire Sizes, on Riser Diagram unless a schedule is placed in Specifications

111.1.1. A demand factor as permitted by the National Electrical Code may be applied to the total wattage. This demand factor will be 100 per cent for all retail stores and for small buildings of any occupancy.

111.1.2. Having determined the maximum demand in watts (total computed wattage x demand factor) for each feeder, the current per feeder is calculated as follows:

Two-wire, 115-volt system	$\frac{\text{Watts}}{115} = \text{amp.}$
Three-wire, 115-230-volt system	$\frac{\text{Watts}}{230} = \text{amp.}$
Four-wire, three phase, 120-208-volt system	$\frac{\text{Watts}}{360} = \text{amp.}$

111.2. *Voltage drop:* The Lighting Standards, Section 310.2, call for a voltage drop not exceeding 1.5 per cent in the feeder system from the service entrance to any panelboard. Using the maximum demand amperes computed as explained above, the size of conductors required for 1.5 per cent drop should be calculated (Section 310.1) and this size should be used if it is larger than the size required for carrying capacity.

111.3. *Provision for future increase in feeder capacity:* All branch circuit calculations are based upon a possible future increase of 50 per cent in the load on 15-amp. circuits and the substitution of lamps one size larger than the original lamps on heavy-duty lamp circuits. In order to make it possible to use this excess circuit capacity, provision must be made for a corresponding increase in the feeder capacity. This may be done (1) by installing oversize feeders originally, (2) by installing oversize conduits so that the original feeders may be replaced with feeders of larger size, or (3) by arranging the installation so that additional feeders can be installed at some future time at a minimum of expense.

(1) Where the conductor size required for the initial load is No. 8 or smaller, conductors large enough to provide for the future increase in load should be provided in the original installation. The additional cost of the larger conductors in such a case will be so small as to be unimportant.

(2) Up to a conductor size of about No. 1, conduits should be installed of sufficient size to contain feeder conductors of the size required for the future increase in loading. This will usually require, if the three-wire system is used, 1½-in. conduit for No. 6 or No. 4 conductors and 2-in. conduit for No. 2 or No. 1. Then when the need arises the

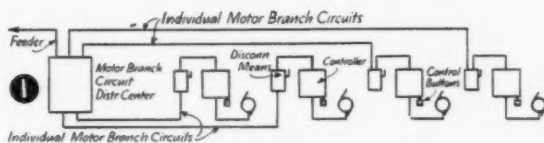
original conductors can be withdrawn and replaced with conductors of larger size.

(3) Where the conductors are replaced as in (2) the original conductors have only a scrap value. To avoid this waste in the case of large cables, spare conduits may be installed so that the increased capacity may be provided by installing additional feeder cables. This method, however, requires that the original layout be planned with special care. It is not good practice to multiple two conductors of unequal size, hence the installation should be planned to utilize the additional feeder capacity by sectionalizing each panelboard or by changing the connections so as to supply certain panelboards by the new feeders.

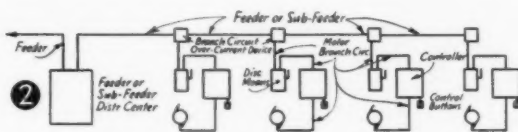
## 112. Power Feeders

112.1. Because of the varying factors in power feeder design as to routing, grouping of motors and voltage loss, five common methods of design or types of layouts must be considered.

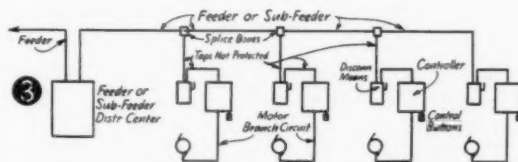
### 112.2. Types of Layouts.



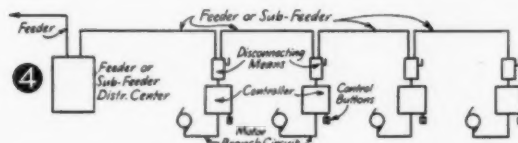
(1) A separate circuit may be run to each motor from a branch-circuit distribution center.



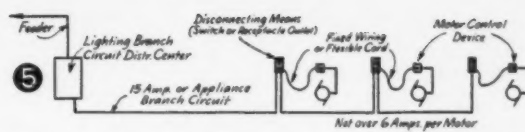
(2) A feeder or sub-feeder may be carried around the building with branch circuits tapped to the feeder at various points, no branch circuit distribution center being used.



(3) A feeder or sub-feeder may be carried around the building with sub-feeder taps, having no individual overcurrent protection, carried direct to the disconnecting means or controller for each motor. In this case, the branch-circuit overcurrent device is usually omitted and the motor branch circuit originates at the controller.



(4) A feeder or sub-feeder may be carried direct to the disconnecting means or controller for each one of the group of motors. Otherwise the layout is the same as in (3).



(5) A group of small motors, each having a full-load current rating not exceeding 6 amp., may be supplied by a 15-amp. branch circuit or an appliance circuit.

For conditions under which each of the foregoing types of layouts can be used and the installation requirements applying in each case, see the National Electrical Code.

### 112.3. Application of Various Types of Layouts.

112.3.1. Type (1) can be used under any condition and is the type most commonly used. It is usually the preferable type for supplying the miscellaneous power loads in a commercial or public building and is also common in industrial plants.

112.3.2. The use of Types (2), (3) and (4) is limited chiefly to industrial plants where a large number of small motors is used to drive individual machines, such as looms in a cotton mill, or cigarette-making machines. Type (2) requires for each motor a branch-circuit overcurrent device. In Type (3), no branch-circuit overcurrent device is required, but the conductors from the sub-feeder to the controller must be larger than in Type (2). Type (4) will show an economy in cost over either Type (2) or Type (3) if the subfeeder can be economically brought direct to each controller.

112.3.3. Type (5) is merely a means of providing for small motors used with household and commercial appliances, by permitting them to be connected to lighting or appliance branch circuits. This is not to be considered as a type of layout having application in a factory.

112.3.4. For power applications in industrial plants, the first four types of layouts may be considered as on a par as regards serviceability. The choice between these types should be made on the basis of economy in cost of installation and flexibility, i.e., adaptability to changes in sizes and locations of motors.

### 112.4. Voltage Drop and Carrying Capacity of Conductors.

112.4.1. All conductors must have sufficient carrying capacity, according to the National Electrical Code requirements, and should also be of such size that the total voltage drop to any motor will not exceed 5 per cent.

112.4.2. On any system operating at 208 volts or higher, it is recommended that the voltage drop in motor branch circuits should not exceed one per cent, in which case a drop of 4 per cent in the feeders is allowable. It will be found that with the minimum conductor sizes permitted by the National Code, the feeder voltage drop will exceed the 4 per cent limit only where a feeder is unusually long. In any case where the drop will exceed 3 per cent, the annual cost of the kilowatt-hours consumed in copper losses should be computed and consideration should be given to the installation of larger conductors in order to reduce this loss.

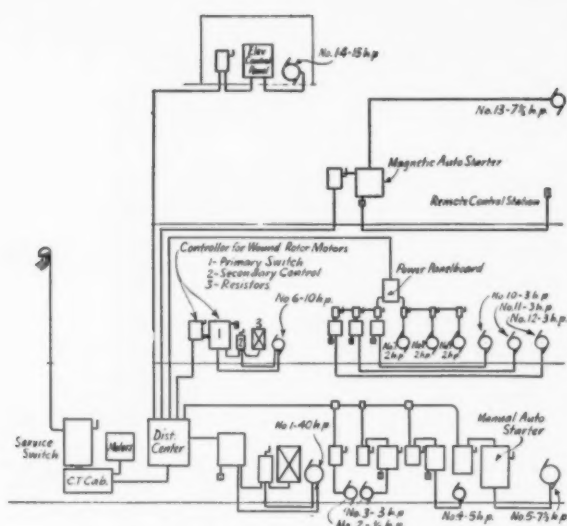
112.4.3. In an industrial plant it is almost always desirable to install service and feeder conductors of larger sizes than are required for the initial load. Beside providing for load increases, the excess size will also have the advantage of reducing the copper loss.

## 113. Feeder Distribution Center for Light or Power

113.1. In a small wiring installation only a single feeder may be required, extending from the service equipment to one or more branch-circuit panelboards or motors. If the layout calls for two or more feeders, a feeder distribution center must be installed to provide for the protection of each feeder.

113.2. The modern types of feeder distribution centers in-





**Power Feeder & Branch Circuit Riser Diagram**  
Insert Schedule of Raceway and Wire Sizes, on Riser  
Diagram unless a schedule is placed in Specifications

clude dead-front panelboards, dead-front switchboards, and assemblies of enclosed, externally-operable units, composed of either switches and fuses, or circuit breakers. The equipment for a small installation is termed a panelboard and is usually mounted in a cabinet on or in a wall, while for a large installation a switchboard standing on the floor and accessible from the front or rear is more suitable.

113.3. Assemblies of externally-operable switches or circuit breakers are adaptable to all installations, small or large.

113.4. Suitable provision should be made for the protection of feeders of increased size. (See Sections 310.3 and 405 of the Standards.) All that is necessary is to provide space for the future installation of larger switches or circuit breakers, and means of making connections to the larger equipment without disturbing such of the original equipment as may be retained. If a panelboard is used, it is suggested that it be of the sectional type, with space in the cabinet to contain the larger equipment and with buses large enough to carry 150 per cent of the initial load. If a switchboard or assembly of unit devices is used, it is suggested that the buses be as recommended for panelboards and that the switchboard or assembly be specially designed to accommodate the larger equipment.

#### 114. Service

114.1. *Initial load:* The first step in determining the size of the service conductors and the capacity of the service equipment (switch and fuses, or circuit breaker) is to compute the total initial load by totalling the feeder loads. These should be the loads computed for the various feeders before any permissible demand factors less than 100 per cent have been applied. Any power load should be segregated. By "power load" is meant any load consisting of motors or electrically-heated equipment that is not to be supplied by "15-ampere" or "appliance" branch circuits as defined in the National Electrical Code.

The demand factor permitted by the National Electrical Code should be applied to the total load other than power load. In most cases, no demand factor less than 100 per cent should be applied to the power load. For a single service supplying a combined load of lighting and power, the total service capacity will be the sum of the lighting load after applying the demand factor, and the power load.

114.2. *Provision for increased capacity:* Provision having

been made in the other portions of the wiring system for a future increase in the lighting load, provision should also be made for a similar increase in the service capacity.

114.2.1. The original installation should include service entrance conductors and service equipment having the required excess capacity in every case where the rating of the equipment, as thus determined, will not exceed 400 amp. For any given initial load, the size of conductors and rating of the service switch and fuses, or circuit breaker, may be taken from the accompanying table if an increase of 50 per cent is to be provided for.

#### 114.2.2 SERVICE SWITCH AND WIRE SIZES

Initial Load Amperes	Service Switch Amperes	Wire Size
1-23	60	8
24-33	60	6
34-47	100	4
48-60	100	2
61-67	100	1
68-83	200	0
84-100	200	00
101-117	200	000
118-133	200	0000
134-150	400	0000
151-167	400	250,000 CM
168-183	400	300,000 CM
184-200	400	350,000 CM
201-217	400	400,000 CM
218-267	400	500,000 CM

114.2.3. Where the calculated future load exceeds 400 amp., an individual study should be made of each case. Due weight should be given to each of the following considerations:

- In any building having an expectant life of ten years or more, it is highly probable that some additional service capacity will be needed.
- In most cases, additional capacity can be provided only by tearing out and completely replacing the original service conductors and service equipment and the larger the service, the greater the expense involved.
- Considerable additional expense is involved in providing 50 per cent excess capacity in the case of a heavy service and this is a non-productive investment until some part of the excess capacity is utilized.

#### 115. Transformer Stations

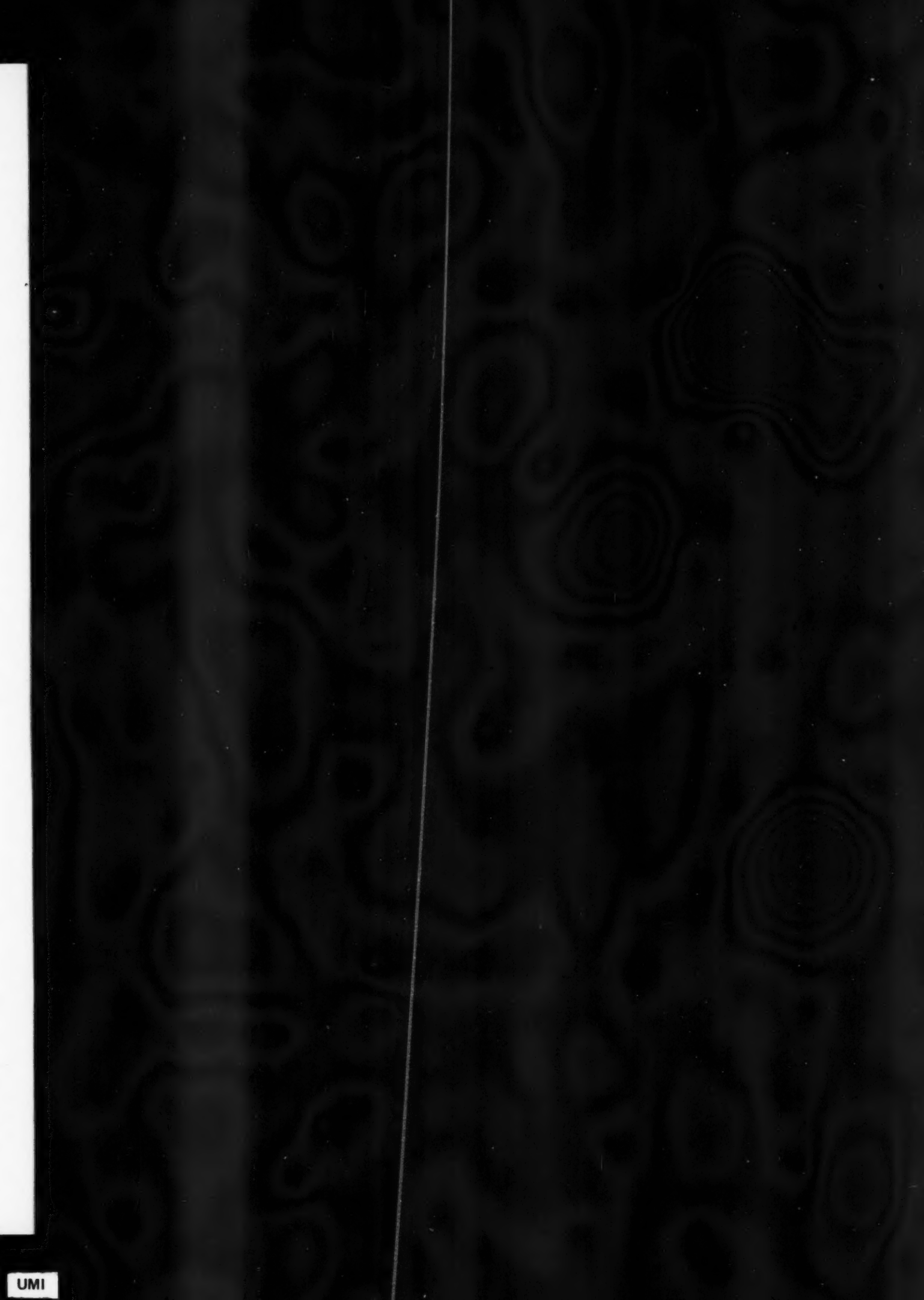
Where the calculated demand load is sufficiently large to make the purchase of "wholesale" power economical, or where the structural design makes it more economical to provide one or more transformer stations in a building, detailed drawings and specifications must be prepared. These details should be prepared after consulting with the local inspection authorities, and with the local power company that is to serve such transformer equipment.

Drawings should be prepared in large scale to supplement the locations shown for such stations on the general wiring plans. A schedule of transformer station materials may be inserted upon the detail drawings, which may be used also as a specification. For more detailed general information regarding transformer stations see Standards, Section 313.

#### 116. Specifications

Upon the completion of the wiring plans, or during the final stages of completion, enough information will have been assembled to prepare the specifications. The procedure for writing specifications is given in the Master Specification Part 7 for commercial and industrial occupancies; and, Part Part 9 for dwellings.







# 201. COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

## Occupancy Recommendations Reminder

### Part 2

# WIRING CHECK CHARTS

Large Commercial, Institutional & Public Bldgs.		Armories	Art Galleries	Auditoriums	Banks	Churches	Clubs	Colleges	Court Houses and Jails	Dormitories	Fire Department Buildings	Hospitals	Hotels	Libraries	Markets, Public	Mausoleums	Medical Center Buildings	Memorials	Museums	Office Buildings	Piers, Ferry and Steamship	Police Stations	Post Offices	Radio Broadcasting	Railroad Stations	Schools	Stores — Department	Stores — Large Variety (5 & 10)	Theaters — Legitimate	Theaters — Moving Picture	Wholesalers (No Manufacturing)
Special Lighting Equipment		Auditorium Effects																													
		Bed Reading Lights																													
Electrically Heated Equipment		Booths																													
		Color Discrimination																													
		Corridor-Room Night Lights																													
		Display Cases																													
		Elevator Cage and Cable																													
		Exits																													
		Exterior Courts and Walks																													
		Exterior Ornamental Floods																													
		Exterior Parking Areas																													
		Fire Escapes & Wells																													
		Gauges and Instruments																													
		Heavy-Duty Portable																													
		Holiday Decorative																													
		Machine Lights — Built-in																													
		Night Watchman																													
		Revolving Door																													
		Signs — Directional																													
		Signs — Outdoor																													
		Signs — Portable																													
		Signs — Window																													
		Spots — Built-in and Portable																													
		Stage Effects																													
		Stairs and Seat Aisles																													
		Sun Lamps																													
		Wall Reflectors																													
		Cooking and Baking																													
		Food Warming																													
		Immersion																													
		Instrument and Machine Elements																													
		Material Conditioning																													
		Metal Melting and Tempering																													
		Room Heating																													
		Sick Room																													
		Soldering																													
		Sterilizing																													
		Toasting																													

# 201. COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

## • Occupancy Recommendations Reminder (continued) •

		Large Commercial, Institutional & Public Bldgs.																																						
		Armories	Art Galleries	Auditoriums	Banks	Churches	Clubs	Colleges	Court Houses and Jails	Dormitories	Fire Department Buildings	Hospitals	Hotels	Libraries	Markets, Public	Museums	Medical Center Buildings	Memorials	Museums	Office Buildings	Piers, Ferry and Steamship	Police Stations	Post Offices	Radio Broadcasting	Railroad Stations	Schools	Stores — Department	Stores — Large Variety (5 & 10)	Theaters — Legitimate	Theaters — Moving Picture	Wholesalers (No Manufacturing)									
Special Controls	Motor-Operated Equipment	Water Heating	Air Conditioning and Circulating	Air Purification (Ozone Mach.)	Boiler Room Apparatus	Buffers — Burnishers — Polishers	Cleaning — Waxing	Compressors	Conveyors	Display and Turntable Motors	Door and Window Closing	Dumb Waiters	Elevators, Escalators, Hoists	Emergency Systems	Fans — Ceiling, Wall and Portable	Fans — Unit Heater and Ventilation	Generators and Special Current Sets	Grinders — Pulverizers	Kitchen Equipment	Laboratory Machines	Office Machines	Pneumatic Tube Systems	Portable Power Equipment	Pumps	Refrigerators	Repair Shop Equipment	Sirens	Temperature Regulation	Water Treatment and Sterilization	Corridor Supervisory Control	Current Failure Throw-over	Dimmers and Reactors	Door and Window Controls	Emergency Stopping	Master Remote Control	Photo-Electric Applications	Program Control	Remote Lockout, Motorized Equipment	Remote Start-Stop-Jog	



Special Controls	Sign Flashing	
	Stair System Controls	
	Temperature Controls	
	Time Switches	
Recording Devices	Watchman Controls	
	Clocks	
	Employee In-and-Out	
	K. W. Consumption	
Communication and Signalling Equipment	Photo-Cell Counting	
	Time Stamps	
	Voice Recorders	
	Watchman	
Alarms	A.D.T. Supervisory Systems	
	Ambulance Signals	
	Annunciators	
	Button Stations & Aux. Contacts	
Miscellaneous	Carriage and Truck Calls	
	Code Calls	
	Doctors Call	
	Elevator Signals	
Communication and Signalling Equipment	Lamp Indicators	
	Nurses Call	
	Organ Systems	
	Paging Systems	
Alarms	Pilots — Booth and Room Occupancy	
	Pilots — Heating Appliances	
	Pilots — Remote Control	
	Projection Equipment	
Miscellaneous	Public Address	
	Radio	
	Sound Reproduction	
	Telegraph	
Communication and Signalling Equipment	Telephone — Private Inter-Comm.	
	Telephone — Public	
	Telephone — Public Booths	
	Telautograph	
Alarms	Vehicle Approach	
	Burglar	
	Fire	
	Fuel Depletion & Tank	
Miscellaneous	Fume and Gas Escape	
	Sprinkler	
	Theft and Vault	
	Noise Interference	
Communication and Signalling Equipment	Doctor and Dentist Equipment	
	Laboratories	
	Optical Apparatus	
	Radio Broadcasting Plants	

# 202. SMALL SHOPS AND STORES

## Occupancy Recommendations Reminder

Small Commercial Occupancies		Small Commercial Occupancies	
Motor Operated Equipment	Electrically Heated Equip.	Lighting Provisions	Small Commercial Occupancies
Motor Operated			Apparel Shops
Air Conditioner			Appliance Stores
Battery Charging & power units			Automobile Sales
Burnisher — Buffer			Bake Shops
Candy Cabinet			Barber and Beauty Shops
Ice Cream Cabinet			Billiards & Bowling
Carbonator			Book Shops
Cash Register			Bus Depots
			Candy and Ice Cream Stores
			Cigar Stores
			Cleaners & Dyers
			Dairy Products
			Dance Halls
			Doctors & Dentists
			Drug Stores
			Florists
			Furniture Stores
			Furriers
			Grocers
			Haberdashers
			Jewelers
			Linear Shops
			Liquor Dispensers
			Liquor Stores
			Meat Markets
			Milliners
			Music Stores
			Nur Shops
			Opticians
			Pet Shops
			Photographers
			Poultry Stores
			Professional Offices
			Real Estate, Insurance
			Restaurants—Lunch Rooms.
			Rug Dealers
			School Supplies
			Shoe Repairing
			Shoe Stores
			Silk Shops
			Stationary Stores
			Stores—(Outlying Bldg.)
			Stores—(Taxpayer Type)
			Tailors
			Ticket Offices
			Undertakers
			Variety Stores (small)

Motor Operated Equipment	Compressor — Air
	Coolers, Water
	Demon. Outlets Heavy Duty Appl.
	Dishwashers
	Dumbwaiter
	Elev. & Escalator
	Fans — Ceiling, Portable, Wall
	Fans — Unit Heater & Ventil.
	Grinders — Coffee, Meat
	Humidifiers — Cigar
	Juicers — Fruit
	Machines, Office
	Machines, Vending
	Mixers — Beverage
	Music Producing
	Oil Burn., Stokers, Gas Valves
Communication — Signals	Pumps — Beer
	Pumps — Fuel, Sump & Water
	Refrigerators
	Sewing Machines
	Slicers
	Tuna Tables — Display
	Vacuum Cleaners
	Washers
	Annunciator
	Bells, Buzzers, Chimes
	Button & Aux. Contacts
	Code Calls, Paging System
	Clocks
	Lamps — Indicating
	Pilots — Cellar, Closet & Room
	Pilots — Heating Appl.
Alarms	Pilots — Remote Controls
	Pilots — Vault & Refrigerator Ltg.
	Public Address
	Radio
	Teleph. — Priv. Inter-Comm.
	Telephone, Public
	Time Stamps
	Burglar
	Fire
	Fuel, Pressure, Temp.
	Sprinkler
	Vault and Storage Room, Photocell
Controls	Bay Area Remote Control
	Booth and Closet Door
	Door Opening (Photo-Cell)
	Night Watchman
	Shock-Proof Outlets
	Sign Flashing
	Time Clock Switches
	Window and Store Remote
	Ventilation

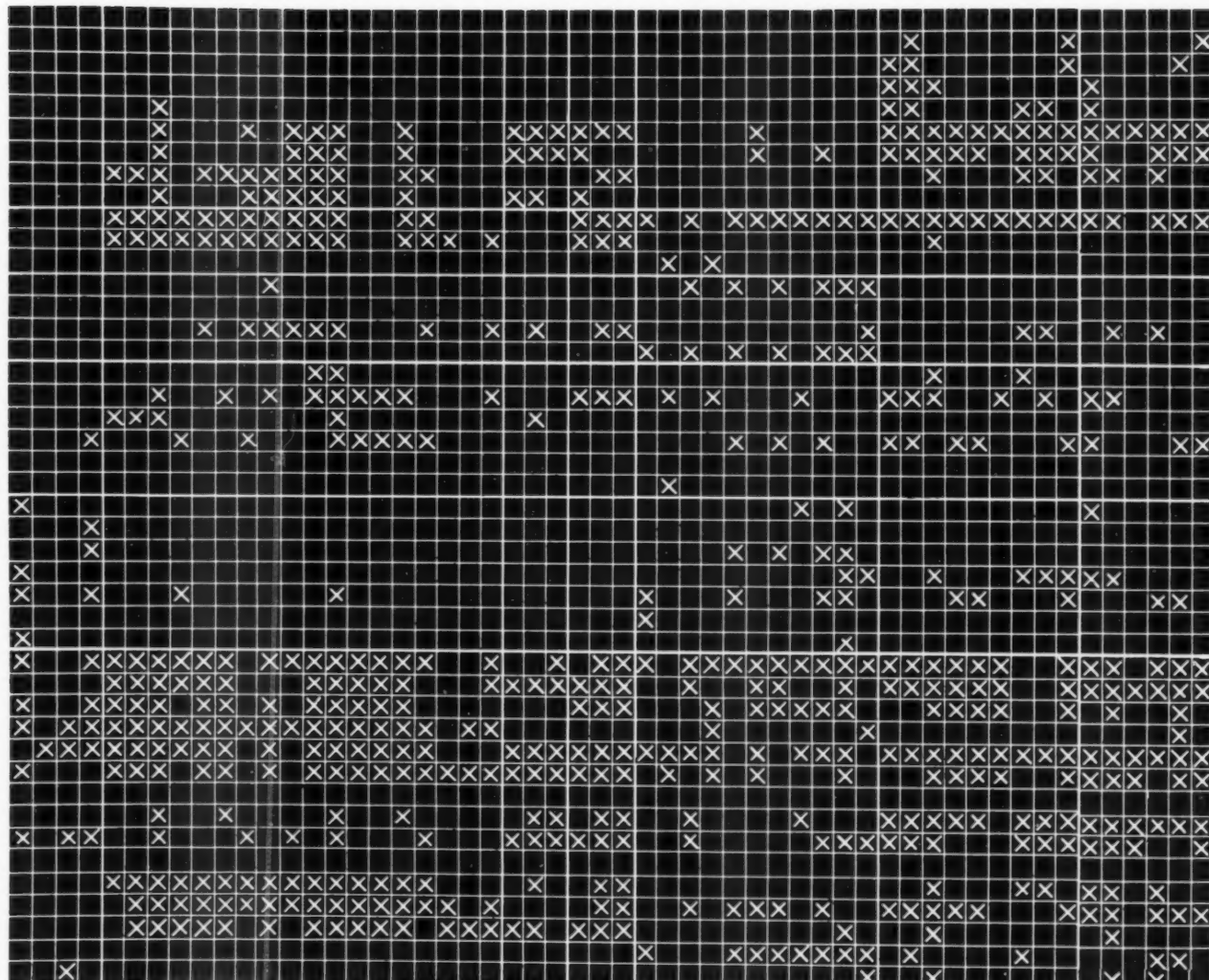


## Functional Reminder

UMI



Power Provisions	Industrial Control Applications	
	Lighting	Machinery
Office Machines		Emergency Stop
Plating		Emergency Trip
Welding		Float and Pressure
Trucks, Monorails		Interlocking — Magnetic
Branding, Labelling, Stamping		Interlocking — Synchronous
Compounds, Materials, Treatment		Jogging — Inching
Equipment Drying and Pre-Heating		Limiters — Friction
Food Preparation and Warming		Limiters — Load
Gas or Vapor Generating		Limiters — Travel
Immersion		Limiters — Speed
Isolated — Crane Cabs		Limiters — Temperature
Isolated — Offices and Rooms		Limiters — Vibration
Isolated — Pits and Towers		Lockout
Laboratories		Remote Control
Machine — Equipped Elements		Reversing
Metals — Annealing		
Metals — Melting		
Metals — Pre-Heating		
Metals — Soldering		
Sick Room		
Soil Heating		
Sterilizing		
Humidity		
Temperature		
Velocity		
Humidistat		
Pyrometer		
Thermometer		
Astronomic		
Dimmer — Reactor		
Emergency Throwover		
Flasher or Drum Selector		
Group-Boys, Aisles, Floors		
Machine — Attached		
Multi-Location (3-way-4-way)		
Pre-Set Time Delay		
Remote Controlled Switch		
Time Clock		
Watchman		



### Functional Reminder (continued)

*Electrical Contracting, June, 1936*

[illegible]

# 204. INDUSTRIAL PLANTS

## Occupancy Hazard and Abuse Reminder

204.

INDUSTRIAL  
PLANTS

Occupancy Hazard  
and Abuse Reminder

Abusive-Deteriorative Character Areas	Hazardous Areas														
		Abrasive Metals, Dusts and Chips	Condensation between Areas	Corrosive Atmospheres	Excessive Temperatures	Frequently Shifted Machinery	Grease and Oil	Portable Machinery	Vibration	Water Dripage, Splashing	Water Floodable Areas, Seepage	1. Highly Flammable Gases, Volatile Materials	2. Explosive Dusts	3. Ignitable Fibres and Materials (Production)	4. Ignitable Fibres and Materials (Storage)

Industrial Processes	Air Cooling & Washing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Annealing & Metal Melting	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Baking and Hardening	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Boiler and Fuel Handling Rooms	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Charging and Piling	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Cleaning and Wash Racks	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Conveyors	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Cooking Processes	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Crushing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Cutting, Punching, Stamping	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Dipping Tanks and Vats	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Distillation	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Dry Rooms and Tempering	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Electroplating	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Enamelling	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Freezing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Furnace Rooms	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Grain Cleaning, Conditioning and Handling	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Grinding, Planing, Polishing, Sawing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Handling, Loading and Transferring	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Molding and Pressing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Pulverizing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Rolls and Finishing Processes	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Scalding & Steaming	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Spray Booths	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Stocking and Storing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Tank and Bin Emptying	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Tumblers & Shakers	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Vaporizing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Welding	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Abattoir (Slaughter House)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Automobile Manufacturing	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Bakeries	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Breweries	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Canneries	X	X	X	X	X	X	X	X	X	X	X	X	X	X

### Hazardous Conditions That Call for Special Wiring

**ABRASIVE CONDITIONS:** For areas where abrasive metals, dust and chips are encountered in sufficient quantities to be harmful to motor bearings, contact-making devices, and flexible cords or cables, observe such provisions of Article 3265 of the National Electrical Code as are applicable.

**AREAS OF TEMPERATURE DIFFERENCE:** At all places where interior raceway systems are exposed to widely different temperatures, locate at walls, dividing such areas suitable raceway fittings with which to effectively seal off with compound any circulation of air through the raceway. Also require raceways to be uniformly sloped or drained toward vent or bleed holes at fittings or in saddled runs of raceway, for all normally or intermittently cold areas.

**CORROSIVE ATMOSPHERES:** Select and specify equipments and materials that are specifically designed to resist corrosive atmospheres or corrosive climatic regions.

The windings of motors and other insulation should be coated or compounded to resist the specific acids or deteriorants peculiar to the occupancy under consideration. All contact-making devices should be oil-immersed, mercury-tube sealed, or provided with gasketed enclosures. Metallic raceways, enclosures, fittings and supports should employ non-corrosive alloys, or should be treated with non-ferrous, corrosion-resistant materials according to the atmospheres encountered.

**EXCESSIVE TEMPERATURE:** Select and specify equipments, devices and insulated conductors specifically designed to withstand high temperatures.

Motor windings and other insulated conductors should employ compounds that will withstand the maximum sustained temperatures likely to occur. Asbestos compounds or varnished cambric conductor insulation; and asbestos wrappings or braids for flexible cords or cables, are most commonly employed. Device bases, sockets, and enclosures should be made of materials that will not melt or lose their alignment under excessive temperatures. Conductor connections, as in the windings of high-temperature motors, or in outlet boxes, should be made with mechanical solderless connectors, or with soldering alloys having a high melting point. Conductors supplying high-capacity or high-intensity lamps or heating elements should have heat resisting insulation.

**FREQUENTLY SHIFTING MACHINERY:** Special designs should be worked out to permit shifting motors, controllers and panelboards in occupancies the nature of which is such as will require quick re-arrangement of production lines.

For small power units an underfloor raceway system, a universally accessible wireway, or an exposed raceway network with uniformly located junction boxes may be found practicable.

For varied power units, a system of wireways, raceways, or busways, having junction boxes or tapping units at many probable areas of future use should be provided.

**GREASE AND OIL:** Select and specify equipments and insulation specifically designed to withstand grease and oil deterioration for all locations where spillage, splash, drippage or surfaces are oily or greasy and in plant areas where lubrication of machinery is excessive. Insulated conductors should be coated or impregnated with approved oil-resisting compounds, and to resist whatever acid content may be encountered.

**PORTABLE MACHINERY:** All motor-driven portable machines should be provided with permanently wired outlets or plugging facilities to shorten flexible cords or cables to prevent exposure to mechanical injury or abrasion. All outlets for portable motors should be of the polarized type, and cords or cables should include a separate conductor for grounding the motor frame and the controller case.



For traveling machines, such as cranes, hoists, production-line tools, cloth cutters, soldering devices, etc., overhead or wall-mounted trolley conductors or busways, and mobile contact making devices should be given consideration.

**EXCESSIVE VIBRATION:** For all areas where severe machine vibration is likely to occur provide extra safeguards against, (1) loosening of equipment or materials and their fastenings, (2) chafing of cables and conductors, (3) objectionable noises, and (4) dropping out of relays or controller devices.

1. Provide lockwashers and setscrews to secure fastening devices, conduit bushings, grounding bushings, fixture parts, controllers, and motor bases.

2. Provide insulating bushings at all points where wires or cables enter raceways in a deflected or horizontal position.

3. Provide noise-insulating bases for motors, silent transmission devices, and non-chattering control devices, where ordinary noises are likely to be objectionable.

4. Provide magnetic latch-in features where excessive vibration would otherwise disengage or trip mechanically-latched devices.

**WATER DRIPPAGE AND SPLASHING:** Select and specify equipment and devices specifically designed to exclude moisture drizzle or splashing.

Motors and controllers used in such areas should be of water-proof design, with insulation of a moisture-repellent type. Groups of controllers or other devices that are only exposed to overhead drizzle may be provided with drip shields. Steam vapors and prevalent moisture should be excluded from wiring devices and lamp holders by the use of gasketed, vapor-proof types.

**FLOODABLE AREAS OR SEEPAGE:** Wiring systems for occupancies having areas subject to floods or water seepage should be designed to place all important distribution and control equipment above the probable flood level.

Service conductors should be (1) routed in watertight raceways to above-flood-level service equipment, or (2) in watertight raceways to watertight service equipment, thence in watertight raceways to above-flood-level distribution equipment, or (3) run overhead to above-flood-level service equipment. Service entrance conductors that are routed within the building to above-flood-level service equipment must be run in raceways or ducts that are buried in 2 in. of concrete or brick masonry forming the building wall.

All raceways entering floodable areas should be uniformly sloped to drain freely. Raceways should have extra area to facilitate the removal of water-soaked wires and cables. Raceways for rubber covered conductors should be of the size recommended for lead covered wires and cables of equal size. All junction boxes, panelboards and other equipment should be located to provide free working space for two or more men in replacing water-soaked cables, and in swabbing raceways.

All devices in floodable areas should employ bases and other essential parts of a non-absorptive moisture repellent type.

**EXPLOSION HAZARDS:** There are four classes of explosion hazard occupancies on areas. These are detailed for each class in Part 10. Select and specify equipments approved particularly for the class of hazard. Special wiring requirements are given in Article 32 National Electrical Code.

Class I relates to areas where volatile liquids and gases are used; Class II to combustible dusts; Class III to ignitable fibres in processing, and Class IV to ignitable fibres in storage.

Industrial — Group Summary & Above — Hazard Listing	
Chemical Plants	X
Clay Products	X
Coal and Ore Mining	X
Cold Storage Plants	X
Cordage, Rope and Twine	X
Cotton Compresses, Gins, Mills	X
Dairies	X
Distilleries	X
Dry Cleaning and Dyeing	X
Feed Mills	X
Food Processing	X
Foundries	X
Garages	X
Garments-Boots, Shoes, Hatt, Cloths	X
Gas Plants	X
Gasoline Stations	X
Glass Works	X
Grain Elevators	X
Hangars — Aeroplane	X
Ice Plants	X
Industrial Buildings (For Lease)	X
Ink Factories	X
Laundries	X
Leather Manufacturing	X
Loft Buildings	X
Machine Shops	X
Mattress Factories	X
Meat Packing	X
Milling	X
Oil Refining and Bulk Stations	X
Paint Manufacturing	X
Paint Shops	X
Paper Box Manufacturing	X
Paper Manufacturing	X
Power Plants	X
Printing Industry	X
Pumping Stations	X
Pyroilin Plastic (Celluloid)	X
Rayon Plants	X
Rubber Products	X
Sewage Disposal	X
Sheet Metal Works	X
Soap Manufacturing	X
Steel and Iron Mills	X
Storage Battery Manufacturing	X
Structural Steel Fabrication	X
Tanneries	X
Textile Mills	X
Tobacco Products	X
Upholstering	X
Warehouses, Commission and Produce	X
Warehouses, General Merchandise	X
Warehouses, Machinery	X
Warehouses, Paper and Other Combustibles	X
Woodworking	X

# 205. RESIDENCES

## Customer Benefits Reminder

205.

RESIDENCES

Customer Benefits  
Reminder

Subject Headings:

Lighting Outlet Provisions	Residence Lighting	Comfort and Convenience			Household Economy										Security and Protection			Health and Safety										Ornamentation										
		Children Play	Comfortable Temperatures	Entertainment Hospitality	Furniture Rearrangement	Hobby Pursuits	Noise or Disturbance Reduction	Outdoor Games	Reading and Study	Step Saving	Toilet Preparation	Auto and Equipment Maintenance	Breakage and Damage of Furniture	Current Consumption	Food Preparation and Preservation	Fuel Consumption	House Cleaning	Laundry	Pressing and Ironing	Servant Efficiency	Burglar-Proofing Protection	Fire Prevention	Non-Interrupted Power Supply	Water Seepage	Abundant Water Supply	Clean Air	Falls, Stumbling and Bumps	Food Spoilage Control	Pest Care	Physical Culture	Shocks and Burns	Sickroom	Uniform Temperatures	Exterior, Permanent	Exterior, Seasonal	Gardening and Landscaping	Interior, Built-in	Interior, Changeable
Attic Lights and Extension Cord		X																																				
Bath Room — General Lighting																																						
Bath Room — Health Lamp																																						
Bath Room — Shadowless Mirror																																						
Bath Room — Shower Vestibule																																						
Bed Rooms — General Lighting																																						
Bed Rooms — Portable Lighting																																						
Breakfast Rooms and Dinettes																																						
Cellar																																						
Closets, Cupboards and Pantries																																						
Dens																																						
Desks																																						
Dining Room Ceiling																																						
Dining Room Coves																																						
Dining Room Brackets																																						
Entrances — General Illum.																																						
Entrances — House Number																																						
Entrances — Keyhole Spot																																						
Fireplace Log and Grate Illum.																																						
Fountain Spotlights																																						
Fruit and Vegetable Rooms																																						
Furnace, Fuel Room, Gauges																																						
Garage — General																																						
Garage — Work Bench																																						
Halls																																						
Kitchen — General Lighting																																						
Kitchen — Range																																						
Kitchen — Sink																																						
Kitchen — Work Tables																																						
Laundry																																						
Lavatories																																						

Residence Lighting	Play and Recreation Rooms	
	Porch	
Lighting Outdoor Provisions	Portable Decorative	
	Portable Dressing	
Lighting Outdoor Provisions	Portable Reading	
	Refrigerator Room	
Lighting Outdoor Provisions	Solarium, Sun Room	
	Stairways and Landings	
Lighting Outdoor Provisions	Stairway Spots	
	Storage Spaces	
Lighting Outdoor Provisions	Tunnels, Air Chambers and Shafts	
	Vestibules	
Lighting Outdoor Provisions	Work Rooms, Benches and Tables	
	Bug and Insect Killers	
Lighting Outdoor Provisions	Christmas Decorative	
	Courts and Drives	
Lighting Outdoor Provisions	Docks and Landings	
	Entrance Gates	
Lighting Outdoor Provisions	Entrance Lodge	
	Fountains and Pools	
Lighting Outdoor Provisions	Garages, Detached	
	Gardens	
Lighting Outdoor Provisions	Lawn Lighting	
	Outbuildings	
Lighting Outdoor Provisions	Outdoor Games	
	Protective Lighting	
Lighting Outdoor Provisions	Yard Lighting	
	Bath Heater Built-in	
Lighting Outdoor Provisions	Breakfast Room Appliances	
	Dining Room Appliance (Floor)	
Lighting Outdoor Provisions	Dining Room Appliance (Wall)	
	Fireplace Heater	
Lighting Outdoor Provisions	Irons, Portable	
	Kitchen Ironing Outlet	
Lighting Outdoor Provisions	Kitchen Range	
	Laundry Dry Room	
Lighting Outdoor Provisions	Laundry Hand Iron	
	Laundry Ironing and Pressing Mach.	
Lighting Outdoor Provisions	Laundry Table Stove	
	Radiators, Air Type	
Lighting Outdoor Provisions	Radiators, Immersion Elements	
	Outdoor — Kennels	
Lighting Outdoor Provisions	Outdoor — Poultry Houses	
	Outdoor — Soil Heaters	
Lighting Outdoor Provisions	Outdoor — Other Outbuildings	
	Portable Elect. Heated Toys	
Lighting Outdoor Provisions	Portable Food Preparation	
	Portable Hair Dryers and Curlers	
Lighting Outdoor Provisions	Portable Health Treatment	
	Portable Immersion	
Lighting Outdoor Provisions	Portable Room Heat	
	Portable Sicknessroom	
Lighting Outdoor Provisions	Portable Sterilizers	
	Portable Work Shop	
Lighting Outdoor Provisions	Attic Exhaust	
	Garage	
Lighting Outdoor Provisions	Kitchen	

# 205. RESIDENCES

## Customer Benefits Reminder (continued)

Subject Headings:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Motorized Appliances and Equipment	Portable	General	Subject Headings:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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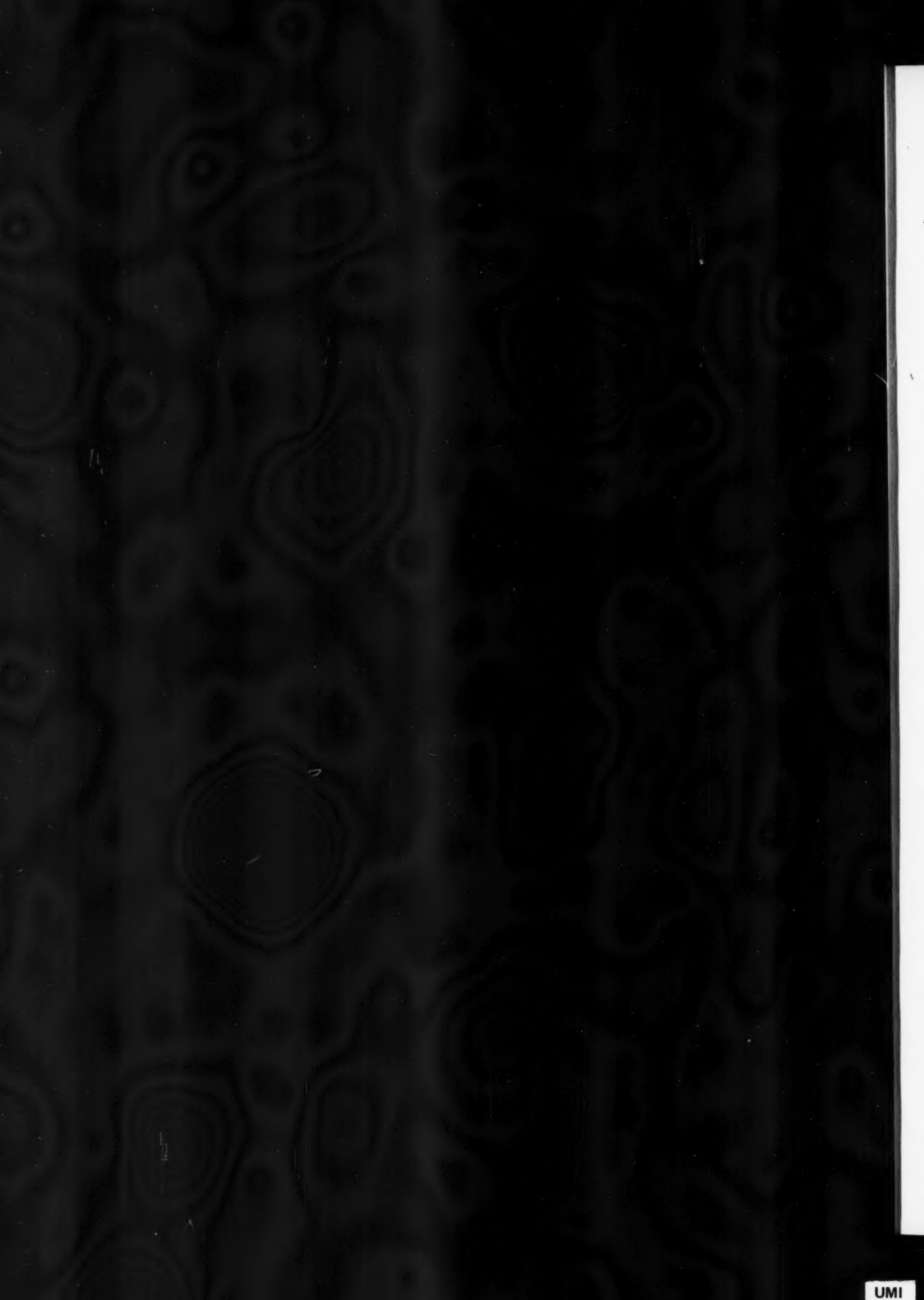
Portable	Waxers and Polishers	
	Burnishers	
Kitchen	Extractors	
	Grinders	
Outdoor	Mixers	
	Peelers	
Equipment	Hedge Clipper	
	Lawn Mowers	
Equipment	Automatic Emergency System Throwover	
	Faucet Controlled Water System	
Equipment	Float Controlled Sump Pump	
	Push Buttons — Elevators, Dumbwaiter	
Equipment	Range-Water Heater Limiter	
	Remote Control, All Distant Equip.	
Equipment	Remote Control, All Inaccessible Equip.	
	Remote Control, Attic Ventilator	
Equipment	Remote Control, Musical Instrument	
	Remote Control, Radio	
Equipment	Remote Control, Water Pumps	
	Thermostats, Heating and Air Cond.	
Equipment	Time Switches, Fixed Devices	
	Attic Lights	
Equipment	Attic Exhaust Fan	
	Bath Room Occupancy	
Equipment	Cellar and Storage Room Lights	
	Garage and Yard Lights	
Equipment	Gas Water Heater Burner Valve	
	Heating Appliance Outlets	
Equipment	Protective Lights	
	Remote Controls for Equipment	
Equipment	Stairs and Halls	
	Automatic-Trip Door Switches	
Equipment	Entrance, Key Switch Master Control	
	Momentary Contact Key Hole Spot	
Equipment	Multi-Location (3 or 4-way) Switches	
	Multi-Location Gas Water Heater Control	
Equipment	Multi-Location Gate or Lodge — Residence	
	Multi-Location Hall Entrances	
Equipment	Multi-Location House — Garage Control	
	Multi-Location Master Control	
Equipment	Multi-Location Protective Controls	
	Multi-Location Radio Control	
Equipment	Multi-Location Stair Flights	
	Multi-Location Tunnel or Shaft Entrances	
Equipment	Multi-Location Two or More Room Entrances	
	Multi-Tone Chime-Gong Control	
Equipment	Radio Silencing	
	Silent-Flip Switches	
Equipment	Single-Location (S.P.), Local Outlets	
	Stumble Light Control	
Equipment	Time Interval Shut-off Control	
	Variable-Intensity Coves	
Equipment	Variable Intensity 3-Element Lamp Fixtures	
	Annunciators	
Equipment	Bells, Buzers and Gongs	
	Burglar Alarms	

**Customer Benefits  
Reminder  
(continued)**

*Electrical Contracting, June, 1936*



Sub-Divided Heavy Circuit





## Standards for Wiring for Lighting

### in Commercial, Public and Industrial Occupancies

#### 301. Outlet Location—Commercial and Public Occupancies

##### 301.1. CEILING OUTLETS FOR GENERAL ILLUMINATION

Ceiling outlets should be, as nearly as possible, uniformly spaced and so located that the spacing will be the same in both main directions. In offices and school rooms, the spacing between adjacent outlets shall not exceed the distance from floor to ceiling. In other interiors, the spacing may be increased to  $1\frac{1}{4}$  times the ceiling height. In halls and corridors lighted from a single row of ceiling outlets, the spacing between outlets shall not exceed 20 ft.

The above provisions do not apply to large spaces where special architectural treatment is employed, such as theaters, auditoriums, churches, large banking rooms, ball rooms, etc.

##### 301.2. STORES—CONVENIENCE OUTLETS IN DISPLAY SPACES

In stores having supporting columns, there shall be installed at least one convenience outlet on or in each supporting column for decorative lighting, electrically-operated equipment or display fixtures.

In stores having no supporting columns, there shall be installed at least one floor outlet for each 400 sq.ft. or major fraction thereof of floor space, these outlets to be uniformly distributed over the entire area.

##### 301.3. STORES—CONVENIENCE OUTLETS IN SHOW WINDOWS

Circuits shall be installed for at least two outlets per window for spotlights or floodlights, and in all cases for at least one outlet for each 8 linear feet of glass, or major fraction thereof. In or near the floor of each window there shall be installed at least one convenience outlet for each 50 sq.ft. or major fraction thereof, of floor or platform area used for window display and in no case shall there be less than one such outlet for each 10 linear feet of plate glass.

##### 301.4. STORES—OUTLETS FOR SHOW WINDOW ILLUMINATION

Junction boxes shall be provided on walls or columns at suitable locations for connection to the lighting equipment. Circuits for show window lighting and for show window spot or flood lights shall terminate at these boxes.

##### 301.5. STORES—OUTLETS FOR SHOW CASE AND WALL CASE LIGHTING

Outlets shall be provided in the floor or wall or both for termination of the circuits for show case and wall case lighting required by Section 305. Such outlets shall be suitably located for connection to the lighting equipment.

##### 301.6. OFFICE SPACES—CONVENIENCE OUTLETS

In each separate office room with 400 sq.ft. or less of floor area, there shall be installed at least one convenience outlet for each 20 linear feet of wall or major fraction thereof. In each separate office room with more than 400 sq.ft. of floor area, there shall be installed at least four convenience outlets for the first 400 sq.ft. of floor area and at least two additional outlets for each additional 400 sq.ft. or major fraction thereof.

Outlets should be placed at suitable locations to serve all parts of the office space.

#### 302. Outlet Location—Industrial Occupancies

##### 302.1. CEILING OUTLETS FOR GENERAL ILLUMINATION

Outlets for general illumination shall be located in accordance with the following data:

TABLE II. SPACING OF OUTLETS FOR GENERAL ILLUMINATION FROM OVERHEAD SOURCES IN INDUSTRIAL OCCUPANCIES

Ceiling height (or height in the clear) Feet	Spacing between outlets* Feet		Maximum spacing between outlets and wall ** Feet
	Recommended	Maximum (for units at ceiling)	
8	7	7½	3
9	8	8	3
10	9	9	3½
11	10	10½	3½
12	10-12	12	3½-4
13	10-12	13	3½-4½
14	10-13	15	4-5
15	10-13	17	4-5
16	10-13	19	4-6
18	10-20	21	4-6
20	18-24	24	5-7
22	20-25	27	5-7
24	20-30	30	6-8
26	25-30	33	8-9
30 and up	25-30	40	8-10

\*Where it is definitely known that some form of indirect lighting will be used, the maximum spacing between outlets may be increased by about 2 ft. and the distance from outside outlets to wall may be increased by about 1 ft.

\*\*These spacings apply where desks, work benches, etc., are to be placed against the wall. Where there will be an aisle or storage space next to the wall, the spacing from outlets to wall may be one-half the spacing between outlets.

In halls and corridors lighted from a single row of outlets, the spacing between outlets shall not exceed 20 ft.

##### 302.2. CONVENIENCE OUTLETS

At least one convenience outlet shall be installed in each bay in both manufacturing and storage spaces.

#### 303. Loads—General Requirements

The number of branch circuits and the capacities of the feeders and service shall be based upon the loads and outlets per circuit specified in the following sections as minimums. Where a known load is to be supplied that will exceed the

loading here specified, the circuit, feeder and circuit capacities shall be based upon such known load.

### 304. Standard Loads for General Illumination

The standard load specified in Table 2 or Table 3 for the given class of occupancy shall be the basis for determining

the minimum required number of branch circuits for general illumination and the minimum required capacities of the service, feeders and subfeeders for supplying this portion of the load. In a few cases, the standard loads given in Table 2 include allowances for convenience outlets as well as for general illumination from overhead lighting equipment.

TABLE 2. STANDARD LOADS FOR ILLUMINATION IN COMMERCIAL AND PUBLIC INTERIORS

Occupancy	Watts per Sq. Ft.	Occupancy	Watts per Sq. Ft.	Occupancy	Watts per Sq. Ft.
1. Armories		d. Private Rooms	3.5	25. Railway	
Drill Sheds and Exhibition Halls	2.5	Including allowance for convenience outlets for local illumination.		a. Depot—Waiting Room	2.5
This does not include lighting circuits for demonstration booths, special exhibit spaces, etc.		e. Operating Room	4.0	b. Ticket Offices—General	2.5
2. Art Galleries		f. Operating Tables or Chairs		On Counters 75 watts per running foot.	
a. General	1.0	Major Surgeries—3000 watts per area.		c. Rest Room, Smoking Room	2.5
b. On Paintings—100 watts per running foot of usable wall area.		Minor Surgeries—1500 watts per area.		d. Baggage Checking Office	3.0
3. Auditoriums	1.5	This and the above figure include allowance for directional control. Special wiring for emergency systems must also be considered.		e. Baggage Storage	1.5
4. Automobile Show Rooms	4.0			f. Concourse	1.5
5. Banks		g. Laboratories	4.0	g. Train Platform	1.0
a. Lobby	2.5	18. Hotels		26. Restaurants, Lunch Rooms and Cafeterias	
b. Counters—75 watts per running foot including service for signs and small motor applications, etc.		a. Lobby	2.5	a. Dining Area	2.5
c. Offices and Cages	4.0	Not including provision for conventions, exhibits.		b. Food Displays—100 watts per running foot of counter (including service aisle).	
6. Barber Shop and Beauty Parlors	4.0	b. Dining Room	3.5	27. Schools	
This does not include circuits for special equipment.		c. Kitchen	2.5	a. Auditoriums	2.5
7. Bowling		d. Bed Rooms	3.0	If to be used as a study hall—4 watts per sq. ft.	
a. Alley Runway and Seats	2.5	Including allowance for convenience outlets.		b. Class and Study Rooms	4.0
b. Pins—300 watts per set of pins.		e. Corridors—10 watts per running foot.		c. Drawing Room	7.0
8. Billiards		f. Writing Room	4.0	d. Laboratories	3.0
a. General	2.5	Including allowance for convenience outlets.		e. Manual Training	4.0
b. Tables—450 watts per table.		19. Library		f. Sewing Room	7.0
9. Churches		a. Reading Rooms	6.0	g. Sight Saving Classes	7.0
a. Auditoriums	1.5	This includes allowance for convenience outlets.		28. Show Cases—50 watts per running foot.	
b. Sunday School Rooms	2.5	b. Stack Room—12 watts per running foot of facing stacks.		29. Show Windows	
c. Pulpit or Rostrum	3.5	20. Moving Picture Theatre		a.* Large Cities	
10. Club Rooms		a. During Intermission	1.5	Brightly Lighted District—350 watts per running foot of glass.	
a. Lounge	1.5	b. During Pictures	.5	Secondary Business Locations—250 watts per running foot of glass.	
b. Reading Rooms	4.0	These figures do not include auxiliary circuits for color or other spectacular effects.		Neighborhood Stores—150 watts per running foot of glass.	
The above two uses are so often combined that the higher figure is advisable. It includes provision for convenience outlets.		21. Museum		b.* Medium Cities	
11. Court Rooms	2.5	a. General	2.5	Brightly Lighted District—250 watts per running foot of glass.	
12. Dance Halls	1.0	b. Local illumination of special exhibits	2.0	Neighborhood Stores—150 watts per running foot of glass frontage.	
No allowance has been included for spectacular lighting, spots, etc.		Total wattage is 2 x total room area.		c.* Small Cities and Towns—150 watts per running foot of glass frontage.	
13. Drafting Rooms	7.0	22. Office Buildings		d. Lighting to Reduce Daylight Window Reflections—750 watts per running foot of glass.	
14. Fire Engine Houses	2.0	a. Private Offices, no close work	3.0	*Values may be reduced 10% for glass on two sides of window, 25% for glass on three sides of window and 40% for island windows.	
15. Gymnasiums		b. Private Offices, with close work	5.0	30. Stores, Large Department and Specialty	
a. Main Floor	3.0	c. General Offices, no close work	2.5	a. Main Floor	4.0
b. Shower Rooms	2.5	d. General Offices, with close work	4.5	b. Other Floors	3.0
c. Locker Rooms	1.5	e. File Room, Vault, etc.	2.5	31. Stores in Outlying Districts	3.0
d. Fencing, Boxing, etc.	4.0	f. Reception Room	1.5	32. Theatres	
e. Handball, Squash, etc.	5.0	23. Post Office		a. Auditoriums	1.5
16. Halls and Interior Passageways—15 watts per running foot.		a. Lobby	2.5	This figure does not include auxiliary circuits for color or other spectacular effects.	
17. Hospitals		b. Sorting, Mailing, etc.	4.0	b. Foyer	2.5
a. Lobby, Reception Room	2.5	c. Storage, File Room, etc.	2.0	c. Lobby	3.5
b. Corridors—8 watts per running foot.		24. Professional Offices		33. Wall Cases—75 watts per running foot.	
c. Wards	3.0	a. Waiting Rooms	2.5		
Including allowance for convenience outlets for local illumination.		b. Consultation Rooms	4.5		
		c. Operating Offices	4.5		
		d. Dental Chairs—600 watts per chair.			

TABLE 3. STANDARD LOADS FOR GENERAL ILLUMINATION FROM OVERHEAD SOURCES IN INDUSTRIAL OCCUPANCIES

In many cases the desirable foot-candle intensity is much higher than that obtainable from prevailing practice in general illumination. In such instances, designated by (\*), the watts per sq. ft.

values specified are intended to provide only for the general illumination needed, and supplementary illumination must be provided by local or localized general methods. The load considera-

tions are thus entirely dependent on specific studies of machine spacing, actual size of areas requiring high intensities, color control, special glare or directional features, etc.

Occupancy	Watts per Sq. Ft.	Occupancy	Watts per Sq. Ft.	Occupancy	Watts per Sq. Ft.
1. Aisles, Stairways, Passageways—10 watts per running foot.		b. Grinding, Cutting Glass to Size, Silvering	4.0	30. Meat Packing	
2. Assembly		c. Fine Grinding, Polishing, Beveling, Etching, Inspection, etc.	*3.0	a. Slaughtering	2.0
a. Rough	2.0			b. Cleaning, Cutting, Cooking, Grinding, Canning, Packing	4.0
b. Medium	4.0	19. Glove Manufacturing		31. Milling—Grain Foods	
c. Fine	*3.0	a. Light Goods		a. Cleaning, Grinding and Rolling	2.0
d. Extra Fine	*3.0	(1) Cutting, Pressing, Knitting, Sorting	2.0	b. Baking or Roasting	4.0
3. Automobile Manufacturing		(2) Stitching, Trimming, Inspecting	4.0	c. Flour Grading	6.0
a. Assembly Line	*2.0	b. Dark Goods		32. Offices	
b. Frame Assembly	3.0	(1) Cutting, Pressing, etc.	4.0	a. Private and General	
c. Body Assembly	4.0	(2) Stitching, Trimming, etc.	*4.0	(1) No close work	2.0
d. Body Finishing and Inspecting	*2.0			(2) Close work	4.0
4. Bakeries	4.0	20. Hangars—Aeroplane		b. Drafting Rooms	7.0
5. Book Binding		a. Storage—Live	2.0	33. Packing and Boxing	2.0
a. Folding, Assembling, Pasting	2.0	b. Repair Department	*3.0	34. Paint Manufacturing	2.0
b. Cutting, Punching, Stitching, Embossing	4.0	21. Hat Manufacturing		35. Paint Shops	
6. Breweries		a. Dyeing, Stiffening, Braiding, Cleaning and Refining		a. Dipping, Spraying, Firing, Rubbing, Ordinary Hand Painting and Finishing	2.0
a. Brew House	1.0	(1) Light	2.0	b. Fine Hand Painting and Finishing	*3.0
b. Boiling, Keg Washing, etc.	2.0	(2) Dark	4.0	c. Extra Fine Hand Painting and Finishing (Automobile Bodies, Piano Cases, etc.)	*2.0
c. Bottling	3.0	b. Forming, Sizing, Pouncing, Flanging, Finishing and Ironing.		36. Paper Box Manufacturing	
7. Candy Making	4.0	(1) Light	3.0	a. Light	2.0
8. Canning and Preserving	4.0	(2) Dark	6.0	b. Dark	4.0
9. Chemical Works		c. Sewing		c. Storage of Stock	1.0
a. Hand Furnaces, Stationary Driers and Crystallizers	1.0	(1) Light	4.0	37. Paper Manufacturing	
b. Mechanical Driers and Crystallizers, Filtrations, Evaporators, Bleaching	2.0	(2) Dark	*3.0	a. Beaters, Grinding, Calendering	2.0
c. Tanks for Cooking, Extractors, Percolators, Nitrators, Electrolytic Cells	3.0	22. Ice Making		b. Finishing, Cutting, Trimming	4.0
10. Clay Products and Cements		a. Engine and Compressor Room	2.0	38. Plating	2.0
a. Grinding, Filter Presses, Kiln Rooms	1.0	23. Inspection		39. Polishing and Burnishing	3.0
b. Moldings, Pressing, Cleaning, Trimming	2.0	a. Rough	2.0	40. Power Plants, Engine Rooms, Boilers	
c. Enameling	3.0	b. Medium	4.0	a. Boilers, Coal and Ash Handling, Storage Battery Rooms	1.0
d. Glazing	4.0	c. Fine	*3.0	b. Auxiliary Equipment, Oil Switches and Transformers	2.0
11. Cloth Products		d. Extra Fine	*4.0	c. Switchboards, Engines, Generators, Blowers, Compressors	3.0
a. Cutting, Inspecting, Sewing		24. Jewelry and Watch Manufacturing	*2.0	41. Printing Industries	
(1) Light Goods	4.0	25. Laundries and Dry Cleaning	4.0	a. Matrixing and Casting	2.0
(2) Dark Goods	*3.0	26. Leather Manufacturing		b. Miscellaneous Machines	3.0
b. Pressing Cloth Treating (Oil Cloth, etc.)		a. Vats	1.0	c. Presses and Electrotyping	4.0
(1) Light Goods	2.0	b. Cleaning, Tanning and Stretching	2.0	d. Lithographing	*4.0
(2) Dark Goods	4.0	c. Cutting, Fleashing and Stuffing	3.0	e. Linotype, Monotype, Typesetting, Imposing Stone, Engraving	*4.0
12. Coal Breaking, Washing, Screening	1.0	d. Finishing and Scarfing	4.0	f. Proof Reading	*3.0
13. Dairy Products	4.0	27. Leather Working		42. Receiving and Shipping	2.0
14. Engraving	*2.0	a. Pressing, Winding and Glazing		43. Rubber Manufacturing and Products	
15. Forge Shops		(1) Light	2.0	a. Calendars, Compounding Mills, Fabric Preparation, Stock Cutting, Tubing Machines, Solid Tire Operations, Mechanical Goods Building, Vulcanizing	2.0
a. Welding	2.0	(2) Dark	4.0	b. Bead Building, Pneumatic Tire Building and Finishing, Inner Tube Operation, Mechanical Goods Trimming, Treading	4.0
16. Foundries		b. Grading, Matching, Cutting, Scarfing		44. Sheet Metal Works	
a. Charging Floor, Tumbling, Cleaning, Pouring, Shaking Out	1.0	Sewing		a. Miscellaneous Machines, Ordinary Bench Work	3.0
b. Rough Molding and Core Making	2.0	(1) Light	4.0		
c. Fine Molding and Core Making	4.0	(2) Dark	*3.0		
17. Garages		28. Locker Rooms	1.0		
a. Storage		29. Machine Shops			
(1) Live	2.0	a. Rough Bench and Machine Work	2.0		
(2) Dead	1.0	b. Medium Bench and Machine Work, Ordinary Automatic Machines, Rough Grinding, Medium Buffing and Polishing	4.0		
b. Repair and Washing	*3.0	c. Fine Bench and Machine Work, Fine Automatic Machines, Medium Grinding, Fine Buffing and Polishing	*4.0		
18. Glass Works		d. Extra Fine Bench and Machine Work, Grinding			
a. Mixing and Furnace Rooms, Pressing and Lehr Glass Blowing Machines	2.0	(1) Fine Work	*4.0		

Occupancy	Watts per Sq. Ft.	Occupancy	Watts per Sq. Ft.	Occupancy	Watts per Sq. Ft.
b. Punches, Presses, Shears, Stamps, Welders, Spinning, Medium Bench Work	4.0	48. Stone Crushing and Screening		b. Silk	
c. Tin Plate Inspection	*3.0	a. Belt Conveyor Tubes, Main Line Shafting Spaces, Chute Rooms, In- side of Bins	1.0	(1) Winding, Throwing, Dyeing	3.0
45. Shoe Manufacturing		b. Primary Breaker Room, Auxiliary Breakers under Bins	1.0	(2) Quilling, Warping, Weaving, Finishing	
a. Hand Turning, Miscellaneous Bench and Machine Work	2.0	c. Screens	2.0	Light Goods	3.0
b. Inspecting and Sorting Raw Mate- rial, Cutting and Stitching		49. Storage Battery Manufacturing		Dark Goods	5.0
(1) Light	4.0	a. Molding of Grids	2.0	c. Woolen	
(2) Dark	*4.0	50. Store and Stock Rooms		(1) Carding, Picking, Washing, Combing	2.0
c. Lasting and Welting	4.0	a. Rough Bulky Material	1.0	(2) Twisting, Dyeing	2.0
46. Soap Manufacturing		b. Medium or Fine Material requiring care	2.0	(3) Drawing-in, Warping— Light Goods	3.0
a. Kettle Houses, Cutting, Soap Chip and Powder	2.0	51. Structural Steel Fabrication	2.0	Dark Goods	5.0
b. Stamping, Wrapping and Packing, Filling and Packing Soap Powder	4.0	52. Sugar Grading	5.0	(4) Weaving— Light Goods	3.0
47. Steel and Iron Mills, Bar, Sheet and Wire Products		53. Testing		Dark Goods	5.0
a. Soaking Pits and Reheating Furnaces	1.0	a. Rough	2.0	(5) Knitting Machines	4.0
b. Charging and Casting Floors	2.0	b. Fine	4.0	55. Tobacco Products	
c. Muck and Heavy Rolling, Shearing (Rough by Gauge), Pickling and Cleaning	2.0	c. Extra Fine Instruments, Scales, etc.	*3.0	a. Drying, Stripping, General	2.0
d. Plate Inspection, Chipping	*4.0	54. Textile Mills		b. Grading and Sorting	*3.0
e. Automatic Machines, Light and Cold Rolling, Wire Drawing, Shearing (fine by line)	3.0	a. Cotton		56. Toilets and Wash Rooms	1.0
		(1) Opening and Lapping, Carding, Drawing, Roving, Dyeing	2.0	57. Upholstering	
		(2) Spooling, Spinning, Drawing, Warping, Weaving, Quilling, In- specting, Knitting, Slashing (over beam end)	4.0	a. Automobile, Coach, Furniture	4.0
				58. Warehouse	1.0
				59. Woodworking	
				a. Rough Sawing and Bench Work	2.0
				b. Sizing, Planing, Rough Sanding, Medium Machine and Bench Work, Gluing, Veneering, Cooperage	4.0
				c. Fine Bench and Machine Work, Fine Sanding and Finishing	6.0

New lighting sources such as high intensity mercury vapor, if extensively used will require less wattage capacity than is provided in the fore-

going tables. Such installation will require individual study as to transformer circuiting and initial starting inrush. Deductions from the fore-

going wattage tables for planning complete high intensity vapor lighting systems have therefore not been advisable at this time.

### 305.1. BRANCH CIRCUITS FOR GENERAL ILLUMINATION

The minimum number of branch circuits required for general illumination shall be based upon the standard loads given in Section 304, Tables 2 and 3, as follows:

For two-wire 15-amp. circuits, the load per circuit should not exceed 1,000 watts.

For multi-wire 15-amp. circuits, the load should not exceed 1,000 watts between each outside wire of the circuit and the neutral wire.

For heavy-duty lamp circuits, the maximum load per circuit depends upon the smallest size of wire used in the circuit and should be 1,500 watts for No. 10 and 3,000 watts for No. 8 or No. 6.

### 305.2. STORE BUILDINGS—CIRCUITS FOR SHOW WINDOW ILLUMINATION

Branch circuit wiring shall be installed to outlets specified in Sections 301.3 and 4 for show window lighting, the circuit capacities to be based upon the wattage specified in Table 2. (See Section 309 for control.)

### 305.3. STORE BUILDINGS—CIRCUITS FOR SHOW CASE AND WALL CASE LIGHTING

Branch circuit wiring shall be installed to outlets specified in Section 301.5 for show case and wall case lighting, the circuit capacities to be based upon the wattage specified in Section 304, Table 2, and the actual or probable lengths to be lighted.

### 305.4. WIRE SIZES

305.4.1. No wire smaller than No. 12 shall be used for any branch circuit.

305.4.2. 15-amp. circuits for general illumination, for show window lighting or for show case lighting: If the single distance from the panelboard to the first outlet exceeds 50 ft. the minimum size of wire for this run shall be No. 10 and

the minimum size between outlets shall be No. 12. Panelboards should be so located that no run from the panelboard to the first outlet will exceed 100 ft.; if in special cases this distance must be exceeded, the loads should be reduced or the wire sizes increased to provide for a voltage drop not exceeding 2 per cent at the last outlet. This paragraph applies to both two-wire circuits and multi-wire circuits.

305.4.3. Heavy-duty lamp branch circuits: No wire smaller than No. 10 shall be used and the voltage drop shall not exceed 2 per cent from the panelboard to any outlet.

### 306. Branch Circuits for Convenience Outlets

#### 306.1. GENERAL REQUIREMENTS

All convenience outlets in walls or columns shall be provided with duplex receptacles.

No convenience outlet shall be supplied by any two-wire circuit, or by any outside wire of a multi-wire circuit, that supplies one or more outlets for general illumination, show window lighting or case lighting. Outlets for show window spot or flood lighting and convenience outlets in or near the floor in show window spaces shall be controlled separately from the outlets for show window illumination called for by Section 301.4.

#### 306.2. WIRE SIZES

No wire smaller than No. 12 shall be used for any circuit supplying convenience outlets. Runs exceeding 100 ft. in length from the panelboard to the first outlet should be avoided wherever practicable, but if unavoidable, such runs shall be not smaller than No. 10 wire and the wire between outlets shall be not smaller than No. 12.

#### 306.3. NUMBER OF CIRCUITS REQUIRED

306.3.1. The maximum number of convenience outlets supplied by one two-wire branch circuit or by one outside



wire of a multi-wire branch circuit shall be as specified below:

Location of Outlets	Max. number of outlets per circuit
Display areas in retail stores.....	6
Store show windows, for spot or flood lights.....	3
Store show windows, in or near floor.....	6
Barber shops and beauty parlors.....	2
Physicians' offices and dentists' offices.....	2
All other locations, except office spaces, manufacturing spaces and storage spaces.....	10

306.3.2. In *Office Spaces*, there shall be at least one branch circuit to supply convenience outlets for every 800 sq.ft. of floor space or major fraction thereof. In applying this standard, each outside wire of a multi-wire circuit shall be considered as one circuit.

306.3.3. In *Manufacturing Spaces*, there shall be at least one branch circuit to supply convenience outlets for every 1,200 sq.ft. of floor space or major fraction thereof. In *Storage Spaces*, in industrial occupancies, there shall be at least one branch circuit to supply convenience outlets for every 2,400 sq.ft. of floor space or major fraction thereof. In applying these standards, each outside wire of a multi-wire branch circuit shall be considered as one circuit. Where convenience outlets are installed to serve a definitely known load, such load shall be taken as the basis for the circuit layout except that the maximum areas per circuit specified above shall not be exceeded.

#### 306.4. ASSUMED LOAD PER CIRCUIT

In determining feeder and service capacities, each two-wire branch circuit and each outside wire of a multi-wire branch circuit supplying convenience outlets shall be taken as representing a load of 1,000 watts, except that where a circuit is to supply a specific known load exceeding 1,000 watts, such known load shall be taken as the circuit load.

### 307. Store Buildings—Provision for Exterior Signs

Where no other provision is made for sign lighting which is at least equivalent, a raceway not smaller than 1-in. shall be run to the front face of the building for each intended or probable individual store occupancy. Such raceway shall terminate outside the building at a point suitable for connection to the sign and shall terminate inside the building at a cabinet, and feeder capacity shall be provided at this cabinet. All calculations of feeder and service capacity shall be based upon a sign load of not less than 50 watts per linear foot of building frontage, only the principal street frontage to be considered. (See Section 309.)

### 308. Panelboards

A panelboard equipped with circuit protection is necessary where the branch circuits are connected to the feeder. Control as well as the required protection is recommended but not required.

On each panelboard one spare circuit shall be provided for each five circuits utilized in the initial installation. Where flush type cabinets are used, provision shall be made for bringing a corresponding number of circuit conductors to the ceiling of the story served, or to the ceiling of the story immediately below, or to both points. Such provision may consist of circuit conductors or empty raceways terminating in boxes suitably located for future extensions.

### 309. Circuit Control

Suitable provision shall be made for the control of all circuits except those supplying convenience outlets only, and

control of the latter type circuits is recommended. Circuits may be controlled individually or, in certain cases, simultaneous control of a group of circuits may be desirable, with or without individual control in addition.

In a retail store, individual control at the panelboards by means of circuit switches or circuit-breakers is usually preferable. In most other occupancies control should be provided by means of local switches or circuit-breakers. In many cases it is necessary to provide two or more switches for the local control of outlets supplied by a single branch circuit.

Provision shall be made for control of all circuits supplying a single sign or an installation of outline lighting by means of an external manually operable switch or circuit-breaker and in each case a suitable time switch shall also be provided to effect the same control.

In a retail store, each circuit supplying outlets in one or more show windows shall be individually controlled and provision shall be made for the installation of a time switch for group control of all such circuits.

Group control of circuits for general illumination or for special decorative effects, by means of remote-control switches each controlling several branch circuits, is desirable in certain large spaces such as large reading rooms, museums, art galleries and ball rooms.

### 310. Feeders

#### 310.1. CARRYING CAPACITY

Every feeder and subfeeder shall have a carrying capacity at least sufficient for the current corresponding to a maximum demand computed as follows:

Compute the standard load for general illumination from the standard load in watts per sq.ft. as given in Section 304, Table 2 or Table 3, and the area of the space served. Add to this load 1,000 watts for each circuit specified herein for purposes other than general illumination and 500 watts for each spare panelboard circuit, and any specific other load not otherwise included. Apply to this total such demand factor as is permitted by the National Electrical Code.

#### 310.2. VOLTAGE DROP

Feeders and subfeeders shall be of such size that, at a load corresponding to the maximum demand computed as stated above, the total voltage drop from the service entrance to any panelboard will not exceed 1.5 per cent.

310.3. *Provision shall be made for a future increase in the capacity of the feeder system to provide for a load of 1,500 watts on each 15-amp. branch circuit installed and such load on each heavy-duty lamp circuit as would result from changing the original lamps to lamps of the next larger size, so that, at such increased load, all feeders will have sufficient carrying capacity and the voltage drop from the service equipment to any panelboard will not exceed 1.5 per cent. This provision may be made in one of three ways:*

(1) By installing feeders of excess size as a part of the original installation. This method shall be employed in every case where conductors not larger than No. 4 are required to meet the requirements for carrying capacity and voltage drop at the increased load.

(2) By installing oversize raceways, so that the conductors originally installed may be withdrawn at any time and replaced by conductors of suitable larger size.

(3) By making suitable provision so that additional feeders can be installed at a minimum of expense to provide the additional capacity.

Where either method (2) or method (3) is used, provision should be made at the feeder distribution center so that any larger feeders or new feeders installed can be properly controlled and protected without involving excessive expense for remodeling the original equipment.

Where method (3) is used, the system should be carefully designed so that the supplementary conductors can be used

as separate feeders, not connected in multiple with the original conductors. Wherever these supplementary feeders must pass through walls, floors, or inaccessible places, suitable raceways should be installed when the original installation is made.

### 311. Feeder Distribution Center

At feeder distribution centers, each feeder shall be controlled and protected by a switch and fuses or by a circuit-breaker.

Except where oversize feeders are provided in the original installation in accordance with method (1) of the preceding section, provision shall be made at the feeder distribution center for the connection and suitable protection of feeders of increased size or supplementary feeders, either by providing the additional protective devices as a part of the original installation or by so designing the original equipment that space, bus capacity and facilities for making connections will be available for the additional equipment.

### 312. Service

The minimum capacity of the service required for the initial load shall be computed as specified for feeders in Section 310.

In every case where the minimum service capacity required for the initial load does not exceed 267 amp., service conductors and service equipment should be installed having the capacity needed for an increased load computed as specified for feeders in Section 310. (See also Section 114.2, Design Procedure.) Where such minimum capacity exceeds 267 amp., a study should be made of each individual case to determine what provisions should be made for a future increase in the load.

### 313. Transformer Stations

Where the demand load will be sufficiently high to justify the installation of one or more privately owned transformer stations on the premises, the following standards should be observed:

313.1. Transformers may be installed to operate on primary feeder distribution systems of various voltages for obtaining "wholesale" power rates.

313.2. The economic limitations of such station applications must be determined on the basis of rate schedules in effect with the local power company.

313.3. Installation design details must conform to Section 50 of the National Electrical Code and local or state regulations. They must also meet the approval of the power supply company.

313.4. Types of stations which may be considered are:

a. Single stations supplied by primary service conductors.  
b. Master stations supplied by primary service conductors, and which in turn supply two or more transformer sub-stations located in various parts of the customer premises.

c. One or more transformer stations located in various parts of the customer premises, such as different floor levels, all served by a primary distribution network.

313.5. Transformer stations may be located (subject to the requirements of Section 313.3) as follows:

a. In one or more approved rooms or vaults in a building.  
b. Upon the building roof.  
c. Attached to the outside of buildings.  
d. Placed on the ground or in underground vaults in suitably guarded enclosures.  
e. Installed above the ground upon poles or other approved supporting members.

313.6. The principal structural requirements are:

a. Wall or roof thicknesses,  
b. Room or vault sizes,  
c. Drainage facilities,  
d. Door construction,  
e. Ventilation,  
f. Location in buildings.

313.7. The principal electrical requirements are:

a. Interrupting capacity of primary switchgear,  
b. Lighting arresters,  
c. Disconnecting devices,  
d. Grounding networks,  
e. Secondary control devices,  
f. Service and inside wiring, clearances, bus structures,  
g. Control and metering transformers and connections.  
h. Arrangement of transformers for ease of emergency isolation, and of replacement in case of burn-out.

## Standards For Power Wiring

Electrical power applications are so numerous and so diversified that it is impossible to compile specific standards covering all cases. The following should, therefore, be considered as general recommendations to be followed as closely as conditions will permit:

### 401. General

A power wiring installation may be considered adequate when due weight has been given to each of the following factors:

- (a) Safety and reliability,
- (b) Avoidance of excessive voltage drop,
- (c) Avoidance of excessive copper loss,
- (d) Flexibility in changing locations of equipment,
- (e) Provision for supplying increased loads.

All of these factors are of importance in an industrial plant of any considerable size, and every such plant is a special problem requiring special study. Power applications in a commercial or public building are of a more nearly permanent character, hence flexibility and provision for increase in the load are usually not so important as in an industrial plant.

### 402. Safety and Reliability

402.1. The National Electrical Code contains specifications for conductor sizes as follows:

402.1.1. For motor branch circuits, the carrying capacity of the conductors shall be not less than 125 per cent of the full-load current of the motor.

402.1.2. For services, feeders or subfeeders the carrying capacity of the conductors shall be not less than 125 per cent of the full-load current of the largest motor plus the sum of the full-load currents of all other motors. Under certain conditions and by special permission of the inspection authority, a demand factor of less than 100 per cent may be applied.

402.2. The National Electrical Code also contains requirements for the over-current protection of motor circuits and motors. In a few cases (manually-started motors of one hp. and smaller) it may be desirable to supplement the requirements for protection of motors.

### 403. Voltage Drop

403.1. In order to insure satisfactory operation, the total voltage drop from the service entrance to any motor should not exceed 5 per cent.

### 403.2. ELECTRIC HEATING EQUIPMENT

403.2.1. As a general rule, the total voltage drop in the conductors supplying an industrial heater should not exceed 2 per cent. In the case of a high-wattage heater for any special application, the drop to be allowed should be based upon the recommendations of the manufacturer of the heater and the electric utility company serving the installation.

403.2.2. Permanently connected electrically heated appliances rated at 1,000 watts or less may be supplied by appliance branch circuits. The total connected load on such a circuit shall not exceed 25 amp. and when all appliances are in operation the voltage drop from the distribution center to any outlet shall not exceed 2 per cent.

403.2.3. Permanently connected electrically heated appliances rated at more than 1,000 watts and not more than 5,000 watts may be supplied by heavy-duty appliance branch circuits. Not more than four appliances shall be supplied by one such circuit and the total connected load on such a circuit shall not exceed 60 amp. When all appliances on one circuit are in operation the voltage drop from the distribution center to any outlet shall not exceed 2 per cent.

403.2.4. All electrically heated appliances rated at more than 5,000 watts shall be supplied by individual branch circuits. The voltage drop in any such circuit shall not exceed 2 per cent.

### 404. Flexibility in Changing Equipment Locations

404.1. The incidental power applications in a commercial, residential or public building may usually be considered as practically permanent and as requiring no special provisions for flexibility. In the majority of industrial plants, changing the locations of the motors is a more or less common occurrence and suitable provisions should be made to meet the probable future conditions. Some degree of flexibility may be secured by means of one or more of the following methods:

404.1.1. Busways arranged for the use of plugging-in devices,

404.1.2. Wireways carrying feeders and motor branch circuits,

404.1.3. An underfloor raceway system, where a large number of small motors is to be supplied and the building is suited to this type of construction.

404.1.4. Oversize raceways, where changes in motor sizes are anticipated.

### 405. Provision for Supplying Increased Loads

On account of the changes in plant layout and equipment that may be expected in the majority of industrial plants, usually involving increased load, it is nearly always advisable to make provisions in the original installation for increasing the capacity of the wiring system. The following items should be considered.

405.1. The service, feeders and subfeeders may be made large enough to provide some excess capacity over the present needs; or raceways may be installed of sufficient size to permit the installation of conductors that will provide for a definite increase in capacity. (See Sections 113.4 and 114.2, Design Procedure.) Demand factors less than 100 per cent should seldom be applied.

405.2. Panelboards should be of the sectional type with interchangeable units, permitting the substitution of control units of larger ratings. Distribution centers consisting of switchboards or assemblies of switches or circuit-breakers should be so designed that the original control units can be replaced by units of larger size and that provision can be made for the control of additional circuits. (See Section 113.4.)

### 406. Distribution Centers

Every feeder, subfeeder or branch circuit distribution center should be provided with a switch and fuses, or a circuit-breaker, for each circuit originating at the distribution center.

# Part 5

## Standards For Wiring in Single-Family Dwellings

### 501. Outlets and Switch Control

Standards for outlets and switch control are as specified in the following table:

Space	Outlets			Switch Control
	Ceil- ing	Bracket	Conveni- ence	
Front entrance (Note 1).....	1 OR	2 or 1		1 inside
For house number.....		1		1 inside
Side and rear entrance.....	1 OR	1		1 inside
Covered porch—Per 100 sq.ft. floor area.....	1 OR	1		1 inside
Porch, terrace or patio—Per 15 ft. of wall space on house side.....			1	1 inside
At front entrance, for decorative lighting.....			1	1 inside
Hall, passage, stairway—At head and foot of stairway (Note 2)....	1 OR	1		2 3-w or 1 3-w. and 14-w.
Additional (if required) for each 15 ft. length of hall (Note 3).....	1 OR	1		1 or 2*
For each 12 ft. length of hall.....			1	
Living room, bedroom, reception hall, library, den, sun room, chil- dren's play room, recreation room, enclosed porch, etc.....	1			1*
Or (Note 4).....	2			2*
For decorative purposes.....		†		1 or more*
Per 12 ft. of wall space (Note 5)....			1	1 or more
In mantel shelf, if possible.....			1	
Dining room, breakfast room or breakfast nook.....	1			1*
For decorative purposes.....		†		1*
Under 100 sq.ft.....			1	
Over 100 sq.ft. (Note 6).....			2 or more	
Kitchen, pantry, each.....	1			1*
At each work area, as range, sink and table.....	1 OR	1		1 or more
At table and each other work area.....			1	
For connection of refrigerator, fan, dishwasher, clock, etc., each.....			1	
Bathroom, large.....	1		1	2
Bathroom, small.....			1	1
In separate shower compartment....	1			1
Each side of mirror.....		1		1
Lavatory—each side of mirror.....		1		1

Note 1—Either one ceiling outlet, one bracket outlet or two bracket outlets may be required, depending upon the architectural arrangement of the front entrance.

Note 2—Outlets for lighting the head of the stairway and

Space	Outlets			Switch Control
	Ceil- ing	Bracket	Conveni- ence	
Laundry—over tubs.....	1			
Over iron location or over ironing board, or both.....	1			
Controlling 1 or more of above.....				1
Over washer (pendant).....			1	
As needed for other appliances.....			1 or more	
Basement—				
Each enclosed space.....	1			
At foot of stairway (Note 7).....	1			1
In front of furnace.....	1			1
For motor-driven tools.....			1 or more	
Attic-unfinished spaces				
Each separate space.....	1			
At head of stairway.....	1			1 at foot of stairs, or 2 3-w.
In suitable location.....			At least 1	
Closets 3 ft. or more deep or having 10 sq.ft. or more floor area except where shelving makes light inef- fective (Note 9).....	1 OR	1		1 (or pull- chain socket)
Garage—				
Over hood of each car.....	1			1
On exterior (Note 9).....		1		2 3-w.
On rear wall, for each car.....			1	
Protective lighting—				
At rear outside corners, immedi- ately under eaves (Note 10).....		2 or more		2 3-w.

\*3-way, or 3-way and 4-way, control should be provided at each regularly used entrance to every room or hall where such entrances are 12 ft. or more apart.

†For decorative purposes as many bracket lighting units can be installed as may be desired.

the foot of the stairway are each to be separately controlled by two 3-way switches. This requires two switches on the first floor and two on the second floor. If there are one or more finished rooms on the third floor, the switch control should be: First floor outlet, one 3-way switch on the first floor and one 3-way on the second floor; second floor outlet, one 3-way switch on the first floor, one 4-way switch on the second floor and one 3-way on the third floor; third floor outlet, one 3-way switch on the second floor and one 3-way on the third floor.



Note 3—One outlet per 15 ft. length is the total number required. An outlet for lighting the head or foot of a stairway should be counted as one of the required hall or passage outlets. Convenience outlets are often desirable in a main hall near the main entrance and at the telephone location, at which location a radio control switch might also be found desirable.

Note 4—When lighting is to be primarily from ceiling fixtures, two ceiling outlets for a room of over 300 sq.ft. area if the length is more than  $1\frac{1}{2}$   $\times$  the width, or if the ceiling is extremely low.

In rooms where several portable lamps will be used, such as a living room, library or sun porch, the convenience outlets should be controlled by a switch. For greater convenience it is desirable to specify that only one of the two receptacles at each duplex convenience outlet shall be controlled by a switch.

Note 5—A more exact rule is: In any unbroken wall space, no point on the wall, at the floor line, to be more than 6 ft. from an outlet in that space, and at least one outlet in each unbroken wall space 3 ft. or more in length.

Note 6—One outlet should be provided in each space adaptable to the use of a buffet or serving table.

Note 7—The switch controlling this outlet should be located at the head of the stairs and should be provided with a bull's-eye pilot light to indicate when the switch is closed. If there is a laundry or any finished room in the basement, the outlet at the foot of the stairs should be controlled by two 3-way switches.

Note 8—A bracket outlet in a closet should be located above the door.

Note 9—One 3-way switch to be in the house at the rear or side entrance and one in the garage.

Note 10—One switch to be in owner's bedroom and one on first floor.

As a further protective measure, one lamp in each room and hall in the entire house may be controlled by a "burglar light" switch in the master bedroom, also, if desired, by one or more switches in other locations, as immediately inside the front entrance. Outlets where this special control is desired should be designated by the letters MS on the plans, and it should be specified that at each outlet so marked, one lamp shall be controlled by the master switch or switches and

that local switch control for these lamps shall also be provided.

## 502. Radio Outlets

Two radio outlets should be provided in the living room and one in each of the following rooms—Dining room, library, sun porch, kitchen, recreation room, and each bedroom.

## 503. 15-Ampere Branch Circuits

At least one 15-amp. branch circuit shall be provided per 500 sq.ft. of floor area. The area shall be computed from the outside dimensions of the house and shall not include open porches, unfinished spaces in the basement and attic, or the garage. These circuits shall supply all outlets except those specified to be supplied by appliance circuits and the outlets supplied shall be, as nearly as possible, equally divided between the circuits.

In each principal room the outlets shall be divided between two or more branch circuits.

## 504. Appliance Branch Circuits

At least one appliance branch circuit shall be installed to supply all convenience outlets in the dining room, breakfast room, breakfast nook, pantry and kitchen. Where the kitchen is being designed as a modern all-electric kitchen, provide at least two appliance circuits for the convenience outlets in these rooms. At least one appliance branch circuit shall be installed to supply the convenience outlets in the laundry, if there is a laundry. Any space provided with fixed laundry tubs shall be considered a laundry. The circuits supplying convenience outlets in the spaces here named shall not supply any other outlet, except that an outlet for a refrigerator motor at any location may be supplied by either one of the specified circuits. No wire smaller than No. 12 shall be used for an appliance branch circuit.

## 505. Individual Appliance Circuits

Individual circuits shall be installed to supply appliances as follows:

Range—three No. 6 wires.

Built-in air heater in each bathroom—2,500 watts capacity.

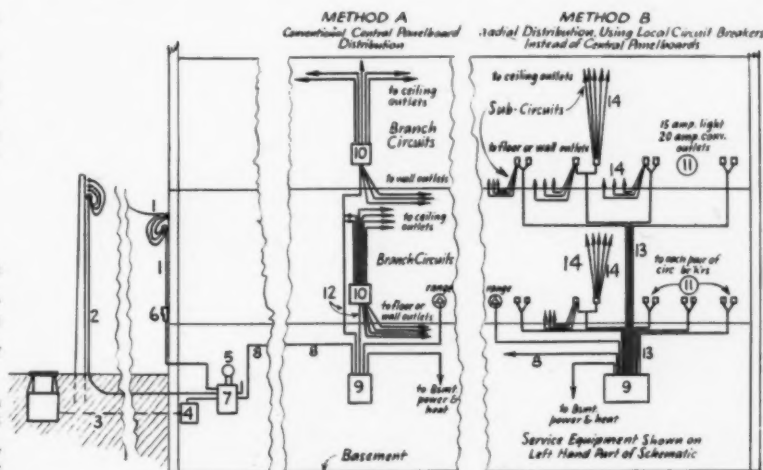
Oil burner or automatic stoker, if such equipment is to be installed, two No. 12 wires.

Pump for water supply system, where service from street mains is not available, two No. 12 wires.

### Residence Service, Distribution, and Circuiting Methods

1. Overhead Service Raceway or Cable attached to building.
2. Overhead Service Raceway or Cable from pole and run underground into building (Instead of No. 1).
3. Underground Service Raceway from power company manhole run underground into building (Instead of No. 1 or No. 2).
4. Junction box for Underground Service.
5. Indoor meter.
6. Outdoor meter (Instead of No. 5).
7. Service Equipment.
8. Main Feeder from No. 7 to No. 9.
9. Main Distribution Center for light, heat or power.
10. Branch Circuit panelboard with fuse or circuit breaker over-current protection, switch control optional.
11. Local circuit breakers in various areas of each floor instead of No. 9.
12. Sub-Feeders from No. 9 to No. 10.
13. Sub-Feeders from No. 9 to No. 11. (In certain cases these may be arranged so as not to require over-current protection at No. 9).
14. Two or more sub-circuits routed radially to all outlets controlled by one local circuit breaker.

Note: Nos. 8, 10 and 12 may be omitted for systems of not more than six circuits if No. 7 is an assembly of approved circuit breakers, and is placed at the nearest readily accessible location at point of service entrance.



Spare circuit connections should be provided in the distribution cabinet for 230-volt circuits of 20-amp. or 25-amp. capacity to a storage water heater and a hot plate in the laundry.

#### 506. Service

The size of the service conductors and the rating of the service equipment shall not be less than as specified in the following table. All services shall be 3-wire. Floor areas shall be computed as specified in Section 503.

Floor Area of Dwelling Sq.Ft.	Size of Service Conductors Gage No.	Rating of Service Equipment	
		Ampere Switch & Fuse	Ampere Circuit-Breaker
Up to 1,000.....	6	60	50
1,000-1,500.....	4	60	70
1,500-3,000.....	4	100	70
3,000-4,000.....	2	100	90

## Part 6

# Standards for Wiring for Lighting in Multi-Family Dwellings

#### 601. Outlets

The minimum requirements for lighting outlets, convenience outlets and switch control within the individual apartments of an apartment building are the same as the applicable requirements for single-family dwellings as stated in Table Q, of Part 5 and the notes supplementary to the table. This will include all items in the table except front entrance, side and rear entrance, porch, stairways, halls and passages, laundry, basement and garage, and other non-rentable spaces.

#### 602. 15-Ampere Branch Circuits

In each individual apartment, at least one 15-amp. branch circuit shall be installed per 500 sq. ft. of floor area. The area shall be computed from the inside dimensions of the apartment. These circuits shall supply all outlets except those specified to be supplied by appliance branch circuits, and the outlets supplied shall be, as nearly as possible, equally divided between the circuits.

#### 603. Appliance Branch Circuits

In each individual apartment at least one appliance branch circuit shall be installed to supply all convenience outlets in the dining room, breakfast room, breakfast nook, pantry and kitchen and this circuit shall not supply any other outlet, except that such a circuit may supply an outlet for a refrigerator motor at any location. No conductor smaller than No. 12 shall be used for an appliance branch circuit.

#### 604. Individual Appliance Circuits

Individual appliance circuits shall be installed to supply a range in each apartment and each other fixed appliance rated at over 1,000 watts.

The range circuit shall consist of three wires not smaller than No. 6 and shall terminate in a 50-amp. 3-pole flush receptacle at a location suitable for making connections to the range. It is recommended that a circuit be installed to each bathroom to supply a heater of at least 1,500 watts rating.

#### 605. Service and Feeders—Carrying Capacity

The capacity of the service and the carrying capacity of feeder conductors shall be based upon loads not smaller than those calculated as follows:

605.1. For lighting and small appliances in apartments allow 2 watts per square foot of floor area, plus 1,000 watts per apartment, and to the load as so computed apply the demand factor permitted by the National Electrical Code.

605.2. Service and feeder capacity shall be provided for an electric range of not less than 8,500 watts rating in each apartment. The required capacity shall be determined by adding together the rated capacities of all ranges to be supplied and applying to the total the demand factor permitted by the National Electrical Code.

605.3. For other loads such as for lighting in halls, stairways, storage rooms and utility rooms and for power and air heaters, the actual or intended load shall be used as the basis for computing carrying capacities.

#### 606. Voltage Drop

Feeders shall be of such size that the voltage drop from the service to any cabinet shall in no case exceed 2 per cent. The total drop from the service equipment to any range outlet shall not exceed 2 per cent.

For computing voltage drops, loads shall be computed as follows:

Lighting and small appliance loads shall be computed as specified in Section 605.1.

For a feeder supplying two or more ranges, add together the rated capacities of all the ranges and to the total apply the demand factor permitted by the National Electrical Code.

For a feeder supply only one range and for a range branch circuit, the range load may be taken as 6,000 watts, regardless of the actual rated capacity of the range.

Note: For telephone system, bell system, door openers, radio systems, etc., see Part 8.

For power wiring see Part 4.

# Master Specifications for Wiring Installations

in Commercial, Public and Industrial Occupancies

Alternate provisions are indicated as a-1, a-2, b-1, b-2, etc. Optional provisions are indicated as a, b, c, etc.

## 701. General Conditions

## 702. Service and Distribution Equipment and Methods

## 703. Installation of Feeders, Circuits and Outlets

## 704. Installation and Furnishing of Motors, Controllers and Heating Equipment

## 705. Specifications for wiring materials and Lighting Equipment. (Except Motors)

\* \* \* \*

## 701. General Conditions

Fill in detailed instructions under the following suggested general subjects. (Suggested wordings for subjects that are particularly applicable to the electrical installation are included herewith.)

### 701.1. General Index of Specifications

### 701.2. Proposals

### 701.3. Terms of Payment

### 701.4. Codes, Permits and Inspections

701.4.1. The installation shall comply with all laws applying to electrical installations in effect in the ..... with the regulations of the National Electrical Code where such regulations do not conflict with the laws in effect, and with the regulations of the public utility company furnishing the electric service.

a-1. (In localities where electrical installations are governed by municipal ordinances.) The contractor shall obtain all permits required by the ordinances of the City of ..... and after completion of the work shall furnish to the owner or architect a certificate of final inspection and approval from the electrical inspection department of the City of .....

a-2. (In localities where no ordinance governing electrical work is in effect.) After completion of the work the contractor shall furnish to the owner or architect a certificate of final inspection and approval from the Underwriters' Inspection Bureau having jurisdiction.

### 701.5. Standards for Material and Workmanship

All materials shall be new and shall conform with the standards of Underwriters' Laboratories, Inc., in every case where such a standard has been established for the particular type of material in question. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance when completed.

## 701.6. Drawings

These specifications are accompanied by floor plans of the building showing the location of all outlets and the switch control,

a. the layout of the branch circuits

b. (and) a riser diagram.

The drawings and these specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

## 701.7. Changes and Additional Work

## 701.8. Liability Insurance

## 701.9. Progress of Work

## 701.10. Guarantee

701.10.1. The contractor shall leave the entire electrical system installed under this contract in proper working order and shall, without additional charge, replace any work or material which develops defects, except from ordinary wear and tear, within one year from the date of the final certificate of approval issued by the inspection department as called for in Section 701.4.

701.10.2. When a part of the electrical system is placed in service prior to the date of final approval, that particular system or partial system shall then commence its one-year period of guarantee. This guarantee shall expire one year after such systems or partial systems are placed in service, without regard to the date when the final certificate of approval covering the entire system is granted.

## 701.11. Substitution of Materials

## 701.12. Cutting and Patching

## 701.13. Painting

## 701.14. Temporary Work

## 701.15. Bond

## 701.16. Approval of Shop Drawings for Special Equipment

## 701.17. Wage Rates

## 701.18. Supervision

## 701.19. Scope of These Specifications

The work to be done under these specifications shall include the furnishing of all labor and material required to complete and leave ready for operation the installation of the following items, in accordance with these specifications and the accompanying drawings:

(List here each system that is to be included in the electrical contract, such as wiring for lighting; power; special systems—radio, telephones, paging, etc. If only installation labor is required for certain work, so state.)



**702. Service and Distribution Equipment and Methods****702.1. Type of Service**

The type of service must in every case be determined by the local power company.

Example 1: The service will be 3-phase, 4-wire, 120-208 volts for light and power.

Example 2: The service will be single-phase, 3-wire, 115-230 volts for light and 3-phase, 3-wire, 230 volts for power.

**702.2. Service Entrance Conductors**

State whether the service entrance conductors are for connection to an overhead service drop, or are to be run underground from a pole, or are to be run underground from underground mains; also the approximate point of entrance to the building. This information must be obtained from the local power company.

State for both light and power the number, size and type of insulation of the conductors.

If for connection to overhead service drop, state whether to be installed in rigid metal conduit, electrical metallic tubing or service entrance cable, and height of termination above ground.

If to be run underground, state whether to be lead-covered cable installed in a raceway, armored underground cable laid directly in the ground, or unarmored underground cable laid directly in the ground.

For methods of determining the conductor and raceway sizes, see Section 312 of the standards.

Example: Service entrance conductors shall be installed for connection to an overhead service drop. The lighting service conductors shall consist of 3 No. 0 rubber-covered conductors and shall be installed in 2-in. rigid metal conduit.

The service conductors for power shall be (state size). Emergency service entrance conductors shall be (state size of wire and raceway), and shall be installed as

- a. A separate service raceway to a separate service switch as shown on plans, or
- b. a separate service switch connected ahead of lighting service switch. (For further details concerning emergency lighting services and equipment, see Section 807 "Emergency Lighting Equipment.")

The raceways shall enter the building at the location indicated on the basement plan, and shall extend to a point 16 ft. above the ground on the outside of the building.

**702.3. Service Equipment**

State for both light and power, and for emergency lighting if used, the location, ampere rating and type of the service equipment (switch and fuses, or circuit breaker).

Specify that the type of equipment, method of mounting and provision for metering shall be in accordance with the service requirements of the local power company.

The ampere rating should be determined as explained in Section 312 of the standards.

Example: Install in the basement, at the location indicated on the floor plan, a 200-amp. fusible service switch for the lighting system. The type of switch, method of mounting and provision for metering shall be in accordance with the service requirements of the ..... Light and Power Company.

**702.4. Transformer Station**

At the location shown on plans

a-1. furnish and install

a-2. furnish all installation labor only for

a complete transformer station in accordance with detail drawings No. .... A schedule of materials and equipments comprising this installation is made a part of the detail drawings and shall form a part of these specifications.

All installation methods, equipments and materials shall be subject to the inspection and final approval of the .....

Power Company. When not otherwise specified, standard materials shall be furnished and installed of makes and grades as hereinafter specified for other parts of the wiring system.

**702.5. Feeder and Power Distribution Centers**

A feeder distribution center may be one of several different types. See Section 113 of Design Procedure.

**702.5.1 (Alternate 1). Dead-front Panelboard.**

Furnish and install at locations shown on the — plan feeder distribution centers consisting of dead-front panelboards designed as follows:

For lighting feeder distribution provide — wire mains with a capacity of — amps., and — wire branches equipped with the following a-1, fuses and switches; a-2, circuit-breakers.

List here the number of branches and ampere capacity of each.

This panelboard shall be designed to accommodate a future increase in the capacity of its branches as follows:

(No.) — amp. branches to a future capacity of — amps. each.

List the number and present sizes of all branches to be included.

The main busses for this panelboard shall be equipped with (select one type): a-1, lugs only; a-2, fuses only; a-3, switch; a-4, fusible switch; a-5, circuit-breaker.

For power feeder distribution provide — wire mains with a capacity of — amps., and — wire branches equipped with the following a-1, fuses and switches; a-2, circuit-breakers.

List here the number of branches and ampere capacity of each.

This panelboard shall be designed to accommodate the future addition of branches as follows:

(No.) — amp. branches.

List the number and sizes of all branches to be provided for.

The main busses for this panelboard shall be equipped with (select one type): a-1, lugs only; a-2, fuses only; a-3, switch; a-4, fusible switch; a-5, circuit-breaker.

All connections shall be equipped with a-1, solder lugs; a-2, solderless terminals. Each panelboard shall be enclosed in a (flush) (surface) type steel cabinet, the cabinet door to be equipped with a latch and lock.

These panelboards shall be type — as manufactured by .....

**702.5.2 (Alternate 2). Dead-front Switchboard.**

Furnish and install at the location shown approximately on the — plan, a dead-front switchboard to serve as a combined distribution center for lighting feeders, and power feeders or circuits.

a-1. The front and end panels of the switchboards shall be constructed of steel plates. The end panels shall extend to the wall in the rear of the board and a door not smaller than 18 in. wide by 6 ft. 6 in. high shall be provided in one of the end panels. The entire structure shall be braced to the wall as may be necessary to hold it rigidly in position.

a-2. The front, ends and rear of the board shall be constructed of steel plates forming a complete enclosure. Doors shall be provided in the rear to give access to the entire space inside the enclosure. The framework shall be so braced that when properly secured to the floor it will form a rigid structure.

b. Connections for all service conductors, feeders and circuits shall consist of bare copper bus bars extended to (select one):

b-1. top of switchboard

b-2. bottom of switchboard

c. Provide for the full length of switchboard (select one):

c-1. A — ga. sheet steel pull box not less than — in. high and — in. deep. This pull box shall be designed for integral mounting at (select one):

c-1.1. top of switchboard; c-1.2. bottom of switchboard.

c-2. A — ga. sheet steel deck plate not less than —



in. wide. This deck plate shall be designed for integral mounting at (select one):

- c-2.1. top of switchboard
- c-2.2. bottom of switchboard

- d. Each feeder leaving the board shall be (select one):
  - d-1. protected by fuses, and controlled by a switch, operable from the front. Fuses shall be accessible from the front of the board.
  - d-2. protected and controlled by a circuit-breaker, operable from the front of the board.

The main bus bars for the lighting section shall have a capacity of — amps., shall be provided with a (select one): a-1, lugs only; a-2, fuses; a-3, switch; a-4, fusible switch; a-5, circuit-breaker. Lighting feeder b-1, switches; b-2, circuit-breakers shall be provided as follows:

List here the number of switches or circuit breakers to be provided and the ampere capacity of each.

All lighting feeder control devices of 100-amp. capacity or smaller shall be convertible in the future to a unit of 50 per cent higher rating. The switchboard shall be so designed and installed that changes may be readily made to provide for an increase of 50 per cent in the total lighting feeder capacity.

Describe main bus bars and feeder or circuit control devices for the power section as done for the lighting section.

All power control devices of 100 amp. capacity or smaller shall be convertible in the future to a unit of 50 per cent high rating. Provide blank spaces and bus bar connecting facilities for the future addition of the following circuit control devices:

(No.) — amp. a-1, switches; a-2, circuit-breakers.

List here the number and size of future control devices.

All wire and cable connections shall be equipped with a-1, solder lugs; a-2, solderless terminals.

This switchboard shall be of type — as manufactured by

702.5.3 (Alternate 3). Assembly of Enclosed Switches or Circuit-Breakers.

Furnish and install at the location shown approximately on the — plan, a feeder distribution center for light and power consisting of an assembly of enclosed

- a-1. externally-operable fusible switches
- a-2. individually enclosed branch-circuit type circuit-breakers mounted on a steel frame.

The mains shall consist of conductors having a carrying capacity of not less than — amp. for the lighting section, and not less than — amp. for the power section.

The main conductors shall be enclosed in auxiliary gutters. Taps to b-1, switches; b-2, circuit-breakers and to feeder conductors shall be enclosed in metal raceways or auxiliary gutters. All c-1, switches; c-2 circuit-breakers and gutters shall be mounted on a substantial frame constructed of structural steel shapes and rigidly secured to the wall. The frame shall be given two coats of rust-resisting paint.

For the control and protection of the feeders the following d-1, switches; d-2 circuit-breakers shall be provided.

List here the number of switches or circuit breakers to be provided for lighting and power, and the ampere rating of each.

Provision shall be made in this assembly for a future increase of 50 per cent in the total feeder capacity, by increasing the size of each feeder where the original conductors are No. 1 or smaller, and by installing auxiliary feeders where the original conductors are larger than No. 1. The distribution center shall be so arranged that units of 100 amp. rating or less can be replaced by units of 50 per cent high rating. Space shall be provided for the following additional units:

List here the number of spaces to be provided for control devices in the lighting section and in the power section of this assembly.

## 702.6. Power and Heating Panelboards

702.6.1. Furnish and install at locations shown on the — plan power panelboards of the dead-front type. Each panelboard shall consist of the size and number of branch a-1, switches; a-2, circuit-breakers; main bus bars and main b-1, lugs; b-2, fuses; b-3, switches; b-4, fusible switches, or b-5, circuit-breakers as follows:

Panel No.	Location	No. and Size branches	No. and Size busses
PA	Basement	2- 60 amp.-3p. 4-100 amp.-3p.	3-300 amp.
PB	1st floor	6-100 amp.-3p.	3-400 amp.

702.6.2. All cable or wire terminals shall be equipped with c-1, solder lugs; c-2, solderless terminals. All cabinets shall be designed for flush mounting except that those marked after its designation with an asterisk (\*) shall be of the surface type.

The power panelboards shall be type — as manufactured by

## 702.7. Lighting Panelboards

702.7.1. For method of determining the spare circuit equipment that should be provided on each panelboard, see Section 308 of Standards.

Lighting-circuit panelboards shall be of the dead-front type and shall have mains arranged for

- a-1. terminal lugs
- a-2. main fuses
- a-3. main switch and fuses
- a-4. main circuit breaker

for

- b-1. 115-230 volt, 3-wire
- b-2. 120/208 volt, 3-phase, 4-wire

service and shall have single-pole overcurrent protection in the branches. Each 15-amp. branch shall be equipped with a

- c-1. plug fuse
- c-2. 30-amp., single-pole tumbler switch and plug fuse connection
- c-3. 15-amp., single-pole circuit-breaker
- d. Branches provided for the protection of heavy-duty lamp circuits shall be equipped with
  - e-1. fuses
  - e-2. fuses and switches
  - e-3. circuit-breakers.

702.7.2. Each panelboard shall be enclosed in a metal cabinet. A typewritten directory of circuits, with metal frame, shall be provided on the inside of the door of each cabinet. All cabinets shall be designed for flush mounting except that those indicated with an asterisk (\*), in the following schedule, shall be surface type.

702.7.3. Panelboards shall be installed having circuit equipment as follows:

Give data here in tabular form as in the following example.

Panel No.	Location	15-amp. Circuits	Heavy-duty Lamp Circuits		Capacity Mains Amps.
			25-amp.	35-amp.	
LB	Basement	8	..	..	60
L1	1st Floor	6	10	4	200
L2	2nd Floor	8	6	2	200
L3	3rd Floor	8	6	2	200
L4	4th Floor	10	6	..	200
LW	1st Floor	10	..	..	100

**703. Installation of Feeders, Circuits and Outlets****703.1. Feeders**

703.1.1. For methods of determining conductor sizes for feeders and the sizes of raceways, see Section 310 of Standards. In addition to the tabulated data called for below, where an installation includes more than three or four feeders a feeder or "riser" diagram should be furnished.

703.1.2. Feeders and sub-feeders as listed in the following schedule shall be installed:

Give data here in tabular form, as in the following example.

Example: Lighting Feeders and Sub-Feeders:

Feeder No.	From	To Panels	Panel Location	Conductors		Conduit Size
				No.	Size	
1	{ Serv. Head	Serv. Switch	Basement	{ 2	500,000 cir mils	3 in.
2	{ Serv. Switch	Dist. Center		{ 1	No. 4/0	
	Dist. Center	LB	Basement	3	No. 6	1½ in.
3	Dist. Center	L1, L2	1st Fl., 2nd Fl.	{ 2	No. 4/0	2½ in.
4	Dist. Center	L3, L4	3rd Fl., 4th Fl.	{ 1	No. 3/0	
5	Dist. Center	LW	1st Fl.	3	No. 3/0	2 in.
Spare	Dist. Center	L1	1st Fl.	3	No. 4	1½ in.
Spare	Dist. Center	L3	3rd Fl.	..	Empty Conduit	2 in.
				..	Empty Conduit	1½ in.

Power Feeders and Sub-Feeders: (Continue as per example above)

**703.2. METHODS OF WIRING**

703.2.1. State in this section which of the following approved wiring methods shall be followed. This may require the separate listing of methods for definite sections or divisions of the installation, such as power and lighting feeders, telephones, fire alarm, sound amplification system, etc. For specifications covering the materials selected and commonly used with approved wiring methods consult specifications for materials on following pages.

Note: Detailed installation requirements for each of these wiring methods will be found in Article 5, National Electrical Code, 1935 Edition.

703.2.2. Approved wiring methods commonly employed for new construction.

- Open wiring
- Concealed knob-and-tube work
- Conduit work
- Surface metal raceways
- Armored cable
- Underfloor raceways
- Non-metallic sheathed cable
- Electrical metallic tubing
- Wireways and busways
- Bare bus-bars and risers
- Non-metallic wiring systems for use in wet places

**703.3. Branch Circuits and Outlets**

703.3.1. The paragraphs next following relate to general installation instructions and therefore require no specific mention of make or grade of materials.

703.3.2. Branch circuits shall be installed as shown on the floor plans. No wire smaller than No. 12 shall be used for any branch circuit unless otherwise noted on plans for special system circuits. Larger sizes shall be used where so indicated on the plans.

703.3.3. Outlets shall be located approximately as shown on the plans and shall be properly centered where located in panelled work or other special interior finish. In general, bracket outlets shall be 6 ft. 6 in. above the floor, receptacle outlets shall be

a-1. located in the baseboard

a-2. 18 in. above the floor and wall switches shall be 5 ft. above the floor.

All lighting outlets shall be equipped with ¾ in. fixture studs except that ceiling outlets in the ..... shall be equipped with special fixture hangers designed to

sustain fixtures weighing ..... lb. each.

703.3.4. Wall switches shall be installed as shown on the plans and shall be connected to provide the control of outlets indicated on the plans. All switches shall unless otherwise noted be of the flush-tumbler type, and except as otherwise indicated shall be single-pole.

703.3.5. Except as otherwise called for by the plans and specifications all receptacles shall be the standard flush-duplex type rated at 15 amp. and 125 volts, adapted to receive standard 2-prong plugs. No plugs for these recep-

tacles are to be furnished under this contract.

703.3.6. The conductors terminating at each wired outlet shall be left not less than 8 in. long within their outlet fitting, to facilitate the installation of devices or fixtures. Where two or more pairs of conductors or circuits enter an outlet, the several pairs or circuits shall be neatly spliced and made mechanically and electrically secure to one or more single or multiple conductors, which conductors shall be not less than 8 in. long within the outlet, to facilitate the installation of devices or fittings. All splices shall be provided with insulation equal to that on the conductors.

**704. Installation and Furnishing of Motors, Controllers and Heating Equipment****704.1. Motors and Control Apparatus—General**

a-1. Motors and motor control apparatus shall be furnished and installed complete with all wiring as listed in the following table and in accordance with other sections of these specifications, except that motors Nos. —, —, —, —, will be furnished and mounted in place by others and control for these motors apparatus will be furnished by others, but shall be installed under this contract.

a-2. All wiring and disconnecting means, where required, shall be furnished and installed for motors listed in the following table, in accordance with other sections of these specifications. Motors and control apparatus will be furnished by others. All control apparatus and the following motors shall be installed under this contract: Motors, Nos. —, —, —, —, —.

Note: List all motors with data as in the following example.

Motor No.	Hp.	Speed rpm	Type	Type of Controller	Machine Driven	Location
1	40	600	Wound rotor	F	Ref. compressor	Basmt.
2	½	1200	Sq. cage	A	D.W. circ. pump	Basmt.
3	3	1800	Sq. cage	B	Vac. pump	Basmt.
4	5	1800	Sq. cage	B	Air compressor	Basmt.
5	7½	1200	Sq. cage	C	Brine pump	Basmt.
6	10	1200	Wound rotor	E	Pulverizer	1st Fl.
13	7½	1200	Sq. cage	D	Conveyor	2nd Fl.
14	15	....	Special	Special	Frnt. elevator	Pent

**704.2. Motors**

All motors will be

- a-1. Single-phase, ——— volt
- a-2. Two-phase, ——— volt
- a-3. Three-phase, ——— volt
- a-4. Direct-current, ——— volt
- a-5. except that motors smaller than  $\frac{1}{4}$  hp. will be single-phase, ——— volt

and shall be of types and speeds as specified in Section 704.1.

b. (Where motors are to be furnished under this contract.) Each motor shall conform with the NEMA standards for motors of the type and speed specified. Except as otherwise specified, all motors shall be of the general-purpose open type. Motors shall be as manufactured by .....

Note: If more than a bare motor is to be furnished, detail specifications should be given here for each motor covering the type of base, such as sliding rails, automatic tension-adjusting base, etc., and the type of mechanical power transmission equipment, such as belt and pulleys, chain drive, gear drive, coupling for direct connection, etc.

**704.3. Motor Control Equipment**

Note: This section includes only the more common types of general-purpose motor control apparatus for alternating-current motors and is not intended to cover controllers for multi-speed motors, synchronous motors, dumbwaiters, elevators or the many special power applications found in industrial plant practice. For all such special applications, detail specifications for each item of equipment should be obtained from the manufacturers.

704.3.1. Each motor rated at  $\frac{1}{6}$  hp. or over shall be equipped with a starter or controller which will provide running overcurrent protection for the motor. Overcurrent devices shall open all leads to the motor except that for 2-phase motors, only three leads are required to be opened. All starters and controllers shall be enclosed in substantial metal enclosures and shall conform with the NEMA Industrial Control Standards. Starters and controllers shall be as manufactured by .....

704.3.2. Type A starters shall be manually operable by means of a lever, knob or pushbuttons, for full-voltage starting.

704.3.3. Type B starters shall be magnetically operable, for full-voltage starting, and shall be provided with undervoltage protection. Provision shall be made for remote control by means of wires leading to other control stations.

704.3.4. Type C starters shall be of the manually-operable autotransformer type, for reduced-voltage starting. Each starter shall be provided with undervoltage protection and shall have a stop pushbutton in the cover.

704.3.5. Type D starters shall be of the magnetically-operated autotransformer type for reduced-voltage starting. Each starter shall be provided with undervoltage protection and shall be arranged for remote control.

704.3.6. Type E starters are for use with wound-rotor motors for starting duty only. Each controller shall consist of an assembly of a magnetically-operated primary switch and a resistor switch with suitable resistors. The primary switch shall provide running overcurrent protection and undervoltage protection for the motor. The resistor switch shall be electrically interlocked with the primary switch so that the primary switch cannot be closed unless all resistors are connected in the primary circuit. Resistor switches shall be of the dial type for motors of 10 hp. rating or less and shall be of the drum type for larger motors.

704.3.7. Type F controllers are for use with wound-rotor motors for speed-regulating duty and shall provide for 50 per cent speed reduction and continuous operation at any speed from maximum to minimum. Type F controllers shall in all other respects conform with the specifications for Type E starters.

704.3.8. All control equipment shall be mounted with operating levers or pushbuttons at a height of approximately four feet above the floor. All necessary expansion bolts, brackets and other structural steel parts shall be furnished to provide secure mounting on walls, columns or machine frames as indicated on the plans or, where so indicated, equipment shall be mounted on frames rigidly constructed of structural steel shapes and secured to the floor by means of expansion bolts.

**704.4. Disconnecting Means**

Where required by the National Electrical Code, a manually operable disconnecting means shall be provided for each motor or for each group of motors driving the several parts of a single machine. Switches and circuit breakers used for this purpose shall be provided with metal enclosures and shall be externally operable and manually operable. The disconnecting means for a permanently installed motor shall be mounted immediately adjacent to, or in the same enclosure with, the motor starter or controller and, if a switch, shall be non-fusible, except that a fusible switch at a distribution center may serve as the disconnecting means if within sight of the motor or if arranged to be locked in the "off" position.

**704.5. Method of Wiring to Motors**

a-1. Each motor rated at more than  $\frac{1}{4}$  hp.

a-2. Each of motors Nos. —, —, —, —, shall be supplied by an individual branch circuit from a distribution center. Conductors shall not be smaller than the minimum sizes permitted by the National Electrical Code and shall be of such size that the voltage drop from the distribution center to the motor will in no case exceed 1 per cent when the motor is carrying its rated full load, except that in circuits to motors Nos. —, —, —, a voltage drop not exceeding 2 per cent will be permissible. Feeder conductors shall be of at least such size that the voltage drop from the service equipment to any distribution center will not exceed 3 per cent when all motors are operating at their rated full load.

b. Motors Nos. —, —, —, —, shall be supplied through group subfeeders from distribution centers. Subfeeders shall either be brought direct to motor starters (or disconnecting means) or shall be connected to starters (or disconnecting means) by means of tap conductors. Subfeeders shall be of at least such size that when all motors are operating at full load the voltage drop from the distribution center to any motor starter will not exceed 2 per cent. Feeders from service equipment to distribution centers shall be of at least such size that when all motors are operating at full load the voltage drop from the service equipment to any distribution center will not exceed 3 per cent.

Note: It is preferable that a complete layout be made with one or more diagrams showing the method of wiring to each motor, the sizes of conductors for all feeders, subfeeders, taps and branch circuits and all raceway sizes. (See Design Procedure, Section 112.) If this is done, the following should be used in place of either a or b.

c-1. Wiring for motors

c-2. Wiring for motors and heating apparatus shall be installed in accordance with the accompanying power wiring diagram, drawing No. —.

**704.6. Wiring for Electrically Heated Equipment**

Note: Electrically heated appliances that constitute only a small part of the total load may usually be supplied through the power feeders from power distribution centers. For the supply of heavy heating loads it may be desirable to specify separate feeders. (See Standards for Power Wiring, Section 404.2.)



**705.1. Wiring System Materials and Fittings**

705.1.1. For all open wiring or knob-and-tube work as called for elsewhere in these specifications, furnish and install non-combustible, non-absorptive insulating bushings, cleats, knobs and tubes as manufactured by ..... and flexible non-metallic tubing as manufactured by ..... For outlet boxes and wire see following paragraphs.

705.1.2. For all conduit work as called for elsewhere in these specifications furnish and install (select one or more types and state where each type shall be used).

- a-1. enamelled rigid steel conduit
- a-2. galvanized rigid steel conduit
- a-3. corrosion resistive, non-ferrous alloy rigid conduit
- a-4. oval conduit
- a-5. flexible metallic conduit.

All conduit, elbows and couplings shall be as manufactured by ..... Rigid steel conduit shall be manufactured in accordance with the industry standards of the Rigid Steel Conduit Manufacturers Association.

705.1.3. For all surface metal raceway wiring as called for elsewhere in these specifications or as indicated on plans, furnish and install surface metal raceways, elbows, and fittings designed for use together, and for the number and sizes of conductors to be enclosed. Metal raceways and fittings shall be as manufactured by .....

705.1.4. For all armored cable wiring as called for elsewhere in these specifications furnish and install types A.C. cable for normally dry locations, or ACL cable for damp locations. Cable shall be as manufactured by .....

705.1.5. For all underfloor raceway wiring as called for elsewhere in these specifications and as indicated on wiring plans, furnish and install (select type)

- a-1. Single raceway for 115-volt service
- a-2. Single raceway for telephone and signalling service
- a-3. Two parallel raceways forming two complete systems, one for 115-volt service and one for telephone and signalling service
- a-4. Multiple cellular steel raceways serving also as structural members of the floor construction.

Raceway shall be of the (select type)

- b-1. metal type
- b-2. fibre type

c. and shall be provided with raceways, junction boxes and fittings as manufactured by .....

705.1.6. Furnish and install as called for elsewhere in these specifications and as indicated on the wiring plans a system of metallic baseboard wireways for

- a-1. single raceway for 115-volt service
- a-2. single raceway for telephone and signalling service
- a-3. two parallel raceways forming two complete systems, one for 115-volt service and one for telephone and signalling service.

This system shall be installed complete with junction boxes, outlet fittings, cross-connected raceways, circuit conductors and wiring devices as indicated on plans. The system shall be manufactured by .....

705.1.7. For all non-metallic sheathed cable wiring as called for elsewhere in these specifications furnish and install cable as manufactured by .....

705.1.8. For all electrical metallic tubing work as called for elsewhere in these specifications furnish and install approved tubing as manufactured by .....

705.1.9. Furnish and install wireways as called for elsewhere in these specifications and as indicated on wiring plans, as manufactured by .....

The cross-sectional area of wireways shall be — in. by — in. Hinged covers and knockouts shall be provided in accordance with manufacturer's details for standard material.

705.1.10. At locations shown on plans furnish and install bus ways as manufactured by .....

The conductors of each busway shall be of the capacity as indicated. All fittings, enclosures, insulating and supporting members shall be as detailed on the plans, and shall be fabricated to approved manufacturer's shop drawings.

(a). Furnish and install plugging devices and enclosures at all points indicated, for the foregoing busway system. These devices shall be of the size and type specified and shall be manufactured by .....

(b). Furnish and install busways and fittings as detailed on electrical plans for mobile device operations. Each section of busway shall have a capacity of — amp., and the mobile devices shall make contact while in motion of not less than — amps. at any point along the length of busway. Mobile contact devices and busway shall be as manufactured by .....

705.1.11. Furnish and install as shown on detail drawing No. —, and as specified thereon, a complete system of bare bus-bars and risers. This system shall include all bus-bar conductors of shapes and dimensions indicated, including insulating posts and blocks, expansion couplings, cable connectors, and other supporting materials, all as manufactured by .....

705.1.12. For all non-metallic wiring in wet places as called for elsewhere in these specifications and as indicated on wiring plans, furnish and install all conductors; non-corrosive, non-absorptive supports and bushings; outlet fittings and devices.

705.1.13. Outlet and switch boxes for standard wiring systems shall be of one or more gangs, as required for each location. Boxes shall be (choose one):

- a-1. Sheet steel, black enamelled
- a-2. Sheet steel, galvanized
- a-3. Cast iron, galvanized
- a-4. Cast iron, enamelled
- a-5. Cast iron, cadmium plated
- a-6. Non-corrosive metal or alloy
- a-7. Porcelain (for insulated systems only)

All boxes shall be manufactured by .....

705.1.14. Explosion-proof boxes shall be of cast iron, suitably finished, or of non-corrosive metal or alloy. Boxes shall be of approved type, and shall be manufactured by .....

705.1.15. Threaded outlet fittings shall have all unused openings properly plugged, and shall be (choose one): a-1, black enamelled cast iron; a-2, galvanized cast iron; a-3, cadmium-plated cast iron; a-4, non-ferrous metal or non-corrosive metal or alloy. They shall be as manufactured by .....

705.1.16. Threadless outlet fittings shall have approved means of fastening box securely to raceway and shall be (choose one): a-1, black-enamelled cast iron; a-2, galvanized cast iron; a-3, cadmium-plated cast iron; a-4, non-ferrous metal or non-corrosive metal or alloy. They shall be as manufactured by .....

705.1.17. Vapor-proof and weatherproof boxes shall be of type particularly approved for the location, and shall provide means for external operation of enclosed devices. Boxes shall be complete with necessary gaskets, screw covers, etc. to make them serviceable in their particular locations. They shall be (choose one): a-1, galvanized cast iron; a-2, cadmium-plated cast iron; a-3, non-ferrous or non-corrosive metal or alloy. They shall be as manufactured by .....



705.1.18. Grounding fittings shall be of type suitable for the particular wiring system being used, and shall provide positive continuity of the ground. They shall be as manufactured by .....

705.1.19. At locations shown on plans furnish and install multi-outlet assembly in one or more continuous sections. These sections shall consist of a metal raceway having outlets to receive standard attachment plugs spaced — in. apart. They shall be as manufactured by .....

705.1.20. For window and cove lighting reflectors furnish and install assemblies of metal raceway or wireway containing lamp receptacles connected on alternate circuits as indicated on wiring plans. They shall be as manufactured by .....

705.1.21. Multiple conductor cables for use as underground feeders or as service conductors, as indicated on the wiring plans shall be (select one or more)

- a-1. SE cable
- a-2. ASE cable
- a-3. CSE cable
- a-4. USE cable

a-5. Other approved assemblies as designated. Cables shall be as manufactured by .....

705.1.22. Furnish and install conductors which are rubber covered and which have a hard slick finish: for open wiring, for knob-and-tube wiring, and for all raceway wiring, except as hereinafter noted. All rubber covered conductors shall have insulation of

- a-1. standard grade
- a-2. intermediate grade
- a-3. 30 per cent grade.

Where other insulation is required by reason of high temperature, the conductor insulation shall be

- b-1. Varnished cambric in sizes No. 6 and larger for permanently dry locations.
- b-2. Asbestos covered and braided conductors type — for dry locations.
- b-3. Asbestos covered and braided conductors type — for hot damp locations.

Where conductors are installed in raceways laid in the ground, or in concrete in direct contact with the ground, they shall be lead covered.

Where conductors are required to be of special insulation, assembly, covering, shielding or shall have extra flexibility, as for special duty systems, these conductors shall be furnished of the type as recommended for use with such special systems. All conductors shall be as manufactured by ..... (Name manufacturer of each type when all types are not made by one manufacturer.)

705.1.23. Conductors shall be spliced with (select one or more):

a-1. Approved wire connectors as manufactured by ..... for conductors of not over — gage.

a-2. Mechanically secure wrapped splices, soldered with fusible metal or alloy, grade — as manufactured by ..... for conductors of not over — gage.

a-3. Mechanically secure splicing sleeves as manufactured by ..... for conductors from — to — gage. Solder shall be of a grade as specified in a-2.

a-4. Mechanically secure solderless cable taps, Type —, as manufactured by ..... for conductors from — to — gage.

b. All bare surfaces of conductor splices shall be insulated with (select one or more):

b-1. — grade rubber tape, — in. wide, as manufactured by .....; and

— grade friction tape, — in. wide, as manufactured by .....

b-2. — grade asbestos tape, — in. wide, as manufactured by .....

b-3. — grade varnished cambric tape, — in. wide, as manufactured by .....

b-4. — grade (cotton (linen) tape, — in. wide, as manufactured by .....

c. At all points where — or more circuit conductors converge at a point beyond their control or distribution center, splices shall be made by means of one or more approved terminal cabinets. These shall be, unless otherwise specified under Part 8, Auxiliary Systems, Type —, as manufactured by ..... They shall provide the correct number of terminals for all conductors involved. Such terminal cabinets shall be located as indicated on the wiring plans and shall be arranged approximately as detailed.

#### 705.2. Wiring Devices

705.2.1. *Night lights* shall be installed complete with lamp receptacle, lamp, plate and hood or other light-shielding means. Night lights shall be Cat. No. — as manufactured by .....

705.2.2. *Aisle lights* shall be complete with box, lamp receptacle and lamp, glass face and metal louvre plate or other means of shielding and directing light. Aisle lights shall be Cat. No. — as manufactured by .....

705.2.3. *Pilot lights* shall be complete with lamp receptacle, lamp, plate and bull's-eye or metal hood. Either lamp or bull's-eye shall be red. Pilot lights shall be Cat. No. — as manufactured by .....

705.2.4. *Plates* shall be (choose one) bakelite or other composition; glass; or genuine brass (choose one), not less than .040 in. thick; not less than .060 in. thick. Brass plates shall be finished to match hardware or wall surface. Plates shall be Cat. No. — as manufactured by .....

705.2.5. *Range receptacles* shall be either totally enclosed surface type, or flush type complete with plug and plate. Receptacles shall be rated at 50-amperes, 250-volts, and shall be Cat. No. — as manufactured by .....

705.2.6. *Flush wall receptacles* shall be duplex, unless otherwise indicated by symbols on plans. They shall be as manufactured by ..... and of the types specified by catalog numbers below. They shall be of bakelite or similar material, and shall conform to the following requirements (choose one):

a. (For high-grade installations.) All receptacles shall be top wired, "T" slot type, Cat. No. —.

b. (For general commercial and residential or apartment installations.) All receptacles shall be side wired, "T" slot type, Cat. No. —.

c. (For inexpensive installations.) All receptacles shall be side wired, parallel slot type, with minimum rating of 15-amperes, 125-volts, Cat. No. —.

705.2.7. *Outlet box lamp receptacles* shall be mounted on 3¼-in. or 4¼-in. cadmium plated box cover, if for use in damp places, or shall be of porcelain if installed in closets, rooms, etc. If not on a switched circuit, shall be pull-cord type. They shall be Cat. No. —, as manufactured by .....

705.2.8. *Watertight, weatherproof or floor receptacles* shall be rated at 15-amperes, 125-volts, unless otherwise indicated on plans, and shall be furnished complete with housing, plate, gasket, screw cover or other means of closing the receptacle against water or weather. Receptacles shall be Cat. No. —, as manufactured by .....

705.2.9. *Industrial receptacles* shall be of amperage rating sufficient to accommodate devices to be connected to them and shall be (designate which):

a. "T" slot

- b. Polarized
- c. Locking type
- d. Three-wire
- e. Four-wire

Cat. No. —, as manufactured by .....

705.2.10. *Locking type receptacles* shall be designed so that plug will not fall or pull out. They shall have amperage rating sufficient to accommodate devices to be connected to them, and shall be 2, 3 or 4-wire as required. They shall be Cat. No. —, as manufactured by .....

705.2.11. *Explosion-proof receptacles* shall be completely housed in accordance with Underwriters' Laboratories requirements and shall be approved for use in the location where they are to be employed. Receptacles shall be of rating shown on plans and shall be Cat. No. —, as manufactured by .....

705.2.12. *Radio receptacles* shall be designed so that only a special plug can be connected to them. Either the face of the receptacle, or the plate, shall be marked to identify the antenna and ground slots. Power outlet shall be mounted on the same plate. Radio receptacles shall be Cat. No. —, as manufactured by .....

705.2.13. *Clock hanger receptacles* shall provide a means for supporting the clock, shall include a single receptacle, and shall have a recess in the plate for the clock cord. Clock hangers shall be Cat. No. —, as manufactured by .....

705.2.14. *Fan hangers* shall be complete with single receptacle, plate, and hanger stud to support the fan independently of the wall plate. Fan hangers shall be Cat. No. —, as manufactured by .....

705.2.15. *Three and four-wire receptacles* shall be of molded composition, and shall be of amperage indicated on plans. Where necessary, one terminal shall be securely grounded to the conduit or raceway system. Three and four wire receptacles shall be Cat. No. —, as manufactured by .....

705.2.16. *Flush tumbler wall switches* shall be as manufactured by ..... and of the types specified by catalog numbers below (choose one or more):

a. For heavy duty circuits over 10 amperes, use Cat. No. — heavy duty totally enclosed switches rated at not less than 20-amperes, 250-volts.

b. For the general control of type C lamp circuits, switches shall be Cat. No. —, totally enclosed and rated at not less than 10-amperes, 125-volts. They shall be equipped with insulated yokes.

c. For light duty type C lamp circuits, switches shall be Cat. No. —, open-cup type, with movable blades that make a tight sliding contact with the fixed terminals. They shall be rated at not less than 10-amperes, 125-volts.

d. For light duty service in residences and apartments, competitive types switches Cat. No. — may be used, provided they have proper amperage capacity for the circuit to be controlled.

General notes applying to the above:

- (1). Flexible rubber handles can usually be supplied on the switches listed under "b" and "c."
- (2). All switches, except those listed under "d" and "e" can be supplied in lock type.
- (3). Switches listed under "b" and "c" can be supplied for momentary contact operation.

705.2.17. *Door switches* shall be supplied complete with box, plate and striking plate and shall be rated at not less than 6-amperes, 125-volts. They shall be Cat. No. —, as manufactured by .....

705.2.18. *Surface type tumbler switches* shall be rated at not less than 6-amperes, 125-volts and shall have (choose one): (a) composition covers; (b) metal covers. They

shall be Cat. No. —, as manufactured by .....

705.2.19. *Rotary switches*, surface type, shall have rating sufficient to accommodate circuit currents to be controlled. They shall be Cat. No. —, as manufactured by .....

705.2.20. *Ceiling and wall pull type switches* shall be rated at not less than 10-amperes, 125-volts, and shall be particularly designed for mounting on outlet boxes, conduit fittings, or for exposed wiring as needed. Cord or chain shall be long enough to be easily reached. They shall be Cat. No. —, as manufactured by .....

705.2.21. *Industrial switches*, either tumbler, push, or rotary, shall be of ample capacity for the circuits they are to control, and where installed in damp or hazardous locations shall be fully protected by approved vapor-proof, or explosion-proof housings. If used for motor circuits, they shall be particularly designed for handling motor currents. They shall be Cat. No. —, as manufactured by .....

705.2.22. *Outdoor switches* for residential or other light duty service shall be rated at not less than 10-amperes, 125-volts, and shall be complete with gasket, plate and operating handle. Outdoor switches for industrial or heavy-duty service shall be totally enclosed in a substantial housing which will effectively exclude water. They shall be Cat. No. —, as manufactured by .....

705.2.23. *Canopy switches* shall be rated at not less than 3-amperes, 125-volts, shall have totally enclosed mechanism, and shall be designed to fasten securely inside the canopy. Cord or chain shall be long enough to be reached easily. Canopy switches shall be Cat. No. —, as manufactured by .....

705.2.24. *Mercury switches* shall be rated at — amperes, — volts, and shall be absolutely noiseless in operation. Handles shall be tumbler type, and switch shall fit under standard wall plate. Switches shall be Cat. No. —, as manufactured by .....

705.2.25. *Remote control switches* for the control of solenoid switches or motor controls shall be of type particularly recommended by the manufacturer of that equipment, and the control buttons or plates shall be marked or otherwise identified for the information of the operator. They shall be Cat. No. —, as manufactured by .....

705.2.26. *Flush wall circuit-breaker switches*, for the protection of branch circuits, shall be rated at not less than 15-amperes, 125-volts; they shall be trip-free from the handle, and shall be of type expressly approved for installation in wall boxes. They shall be Cat. No. —, as manufactured by .....

705.2.27. *Pre-set time delay trip-off wall switches* shall be adjustable for a tripping cycle of not less than — hours after being turned on. They shall have — poles and shall be rated — amps. at (a-1), 115 (a-2), 230 volts. These switches shall be furnished complete with plates for flush mounting and shall be Cat. No. —, as manufactured by .....

705.2.28. *Illuminated house numbers* shall be furnished with the numerals — appearing in a leaded glass field in one or more weatherproof sections, and enclosed in an approved flush metal box and trim, complete with socket. This unit shall be Cat. No. —, as manufactured by .....

### 705.3. Signal System Devices

705.3.1. *Outlet box local fire alarm devices* shall be designed to sound a bell or gong, in case of fire, continuously until reset. Device shall be for operation: a-1, on 110 volts; a-2, for low-voltage. They shall be Cat. No. —, as manufactured by .....

705.3.2. *Annunciators* shall be complete with box, and shall be (choose one): a-1, flush; a-2, surface type. Annunciators shall be (choose one): a-1, manually reset; a-2,

automatically reset. Trim and other exposed parts shall be finished as directed by architect. Annunciators shall have at least two spare "drops". Drops shall be identified by (choose one): a-1, cards in card holders; a-2, numbers on drops; a-3, room or other names lettered at each drop; a-4, engraved names or numbers at each drop. Annunciators shall be Cat. No. —, as manufactured by .....

705.3.3. *Bells, buzzers and gongs* shall be (choose one): a-1, concealed type; a-2, surface type, totally enclosed in metal housing; a-3, open type. For outdoor use, they shall be weatherproof. Tone shall be adjustable, and they shall be designed for the actual voltage delivered at their terminals. Size shall be as indicated on plans. Where two or more devices are installed at same location, notes shall be distinctive. Manufacturer shall be .....

705.3.4. *Chimes* shall be: a-1, metal vibrator type; a-2, tubular type. They shall be: a-1, single-note type; a-2, multiple-note type. Where two or more chimes are installed at the same location, notes shall be distinctive. They shall be Cat. No. —, as manufactured by .....

705.3.5. *Floor pushes, pear pushes and table clamps* shall be manufactured by ..... and shall be supplied with all-rubber or silk-covered cord, not less than 6 ft. long as directed by architect. They shall have self-cleaning contacts, and shall be rugged mechanically.

705.3.6. *Cord pulls* shall be provided with cord reaching within 4 ft. of floor, and mechanism shall be strong enough to return to "Off" position while carrying the weight of a fabric pull cord. They shall be Cat. No. —, as manufactured by .....

705.3.7. *Toy outlets* shall be provided complete with one, two or three polarized receptacles as required to deliver the desired range of low voltages, and plate shall be engraved with the voltages available at each receptacle. Contractor shall furnish five plugs which will fit these receptacles, but will not fit the higher-voltage lighting or power system receptacles. They shall be as manufactured by .....

705.3.8. *Pushbuttons* shall have self-cleaning contacts, and shall be rainproof if installed outdoors. If used on 110 volts, they shall be specially approved for that service. Indoors, pushbuttons shall have pearl or composition centers, metal rims shall be finished as directed by architect, and they shall be mounted (choose one): a-1, on wall outlet plate; a-2, directly in woodwork or other building trim. Pushbuttons for control of multiple-note chimes shall have enough contacts to give desired chime effect. They shall be as manufactured by .....

705.3.9. *Transformers* for signal systems or toy power supply shall have ample capacity for the number of devices to be connected to it, shall be fully approved and shall be designed to give at least three secondary voltages. They shall be Cat. No. —, as manufactured by .....

705.3.10. *Sirens and horns* shall be of size indicated on plans, shall be weatherproof if installed outdoors, and shall be designed for: a-1, 110-volt service; a-2, low-voltage service, on available low-voltage system. They shall be as manufactured by .....

#### 705.4. Control and Protective Devices

705.4.1. Externally operated switches shall be of amperage capacity required for motor or other equipment served, shall have thermal cut-out or fuse protection, and provision shall be made for locking handle. Cover shall be designed so that it cannot be opened while switch is in "ON" position. Casing shall be (choose one): a-1, black enameled; a-2, galvanized; a-3, cadmium plated. Casings for hazardous, wet or corrosive locations shall be specially designed for that service. Switches shall be Cat. No. —, as manufactured by .....

705.4.2. Circuit-breakers, where separately mounted or

housed, shall be of the totally enclosed safety type. Breakers shall have operating characteristics (instantaneous trip, time-delay, etc.) suitable for each particular application. Amperage range and voltage shall be suitable for each application. Circuit-breakers shall be trip-free from the handle. They shall be Cat. No. —, as manufactured by .....

705.4.3. Time clock operated switches shall have the clock and switching mechanisms enclosed in one approved unit housing. The switch shall be — pole, — volt; a-1, single; a-2, double throw; and shall be operated by: b-1, mechanical; b-2, electrical movement. Adjusting facilities shall be provided for the following desired periods of switching "On" and "Off" —. They shall be provided with suitable devices for omitting a 24-hour period. They shall be Cat. No. —, as manufactured by .....

705.4.4 Remote control switches shall be of the: a-1, electrically-held; a-2, mechanically-held type. They shall be — pole, — amp., — volt, b-1, single; b-2, double throw; of the: c-1, completely enclosed; c-2, panel or switchboard mounting type. Mechanically held switches shall have auxiliary coil-opening contact devices. They shall be Cat. No. —, as manufactured by .....

For operating these switches by means of switches located at one or more remote points as indicated on plans, furnish and install Cat. No. — switches, complete with plates, as specified under wiring devices.

705.4.5. Fuses for lighting and appliance branch circuits shall be plug type and all other fuses shall be cartridge type. They shall be of the correct amperage and voltage required to protect the circuits for which they are installed.

All plug fuses shall be as manufactured by .....

All cartridge fuses shall be (choose one):

a-1. non-renewable type

a-2. renewable type.

as manufactured by .....

The contractor shall furnish and install fuses in every fuse terminal or cutout.

#### 705.5 Lighting Equipment

705.5. Furnish and install lighting equipment

a-1. complete with lamps

a-2. without lamps

of the types described below and as specified in the following schedule:

Designate the various types of fixtures or other lighting equipment as Type A, Type B, Type C, etc. Describe each type in a separate paragraph, giving in each case the manufacturer's name, catalog number, and trade name of the fixture, if any.

A complete specification for a type of fixture will usually require a drawing and should include the following data as a minimum.

Number and size of lamp holders and whether key, keyless or pull chain.

Lamp wattage.

Full description of reflector or enclosing glassware—type, size, material, quality, color, etc.

Tubing—Material, size, wall thickness.

Chain—Material, size of link.

Canopies and bodies—Material, thickness.

For portable equipment, type and length of cords.

Finish of metal parts.

Example: Schedule of Lighting Equipment

	Number Type Required	Lamps No.	Length Wattage Overall	Finish	Location
A	24	1	500	48 in.	Old Brass 1st Fl. sales room
B	24	1	300	36 in.	Old Brass 2d Fl. sales room



## Master Specification for Auxiliary Electrical Systems

- 801. Radio Antenna Systems
- 802. Burglar Alarm Systems
- 803. Electric Clock Systems
- 804. Program Systems
- 805. Doctors' Paging Systems
- 806. Emergency Lighting Systems
- 807. Fire Alarm Systems
- 808. General Paging Systems
- 809. Nurses' Calling Systems
- 810. Sound Amplification Systems
- 811. Stage Lighting and Control Equipment
- 812. Private Telephone Systems
- 813. Public Telephone Systems
- 814. Watchman System

\* \* \* \*

### 801. Radio Antenna Systems

#### 801.1. Description

For best results in radio reception the antenna system should be one of the following types:

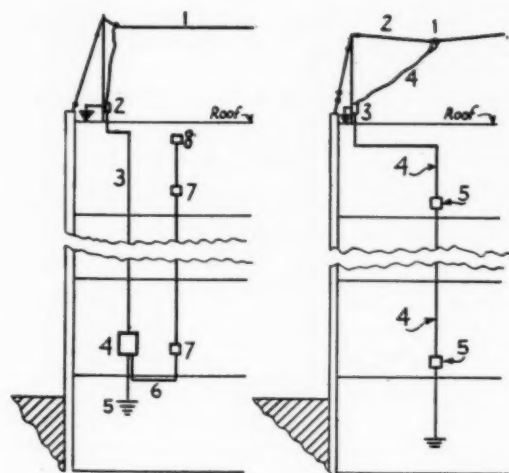
- (A) Doublet antenna with set couplers for all wave reception, for 1 to 25 sets.
- (B) Antenna with amplifier and set couplers for broadcast band reception, for more than 25 sets.

#### Type (A).

The antenna consists of a stranded conductor (7 strands of No. 20 tinned copper or bronze) in two sections insulated from each other. A total length of 60 ft. to 80 ft. is recommended and a clearance of 10 ft. to 15 ft. above a roof, or, if not over a roof, a clearance of at least 30 ft. above the ground. The downlead in a building of wood frame construction may be a No. 18 twisted pair installed in a manner similar to knob-and-tube work, a two-conductor No. 14 armored cable or a No. 18 twisted pair in metal raceway. In fireproof construction the downlead is a No. 18 twisted pair in metal raceway. Each outlet consists of a 4-in. square flush outlet box with 2-gang cover containing a set coupler and provided with a plate, a radio receptacle and a power receptacle.

#### Type (B).

The length and height of the antenna required for this system depends upon the number of receiving sets to be con-



Amplified Antenna System (left)

- |   |  |
|---|--|
| 1—Antenna                                     | 6—Outlet Cable (Downlead Type)                       |
| 2—Antenna Terminal Panel & Lightning Arrester | 7—Radio & Multicoupler Outlet                        |
| 3—Downlead Cable & Raceway                    | 8—Dead-End Corrective Unit (upper end of each stack) |
| 4—Amplifier Panel                             |  |
| 5—System Ground                               |  |

All-Wave Non-Amplified Antenna System (right)

- |                       |                               |
|-----------------------|-------------------------------|
| 1—Antenna Transformer | 4—Downlead Cable              |
| 2—Antenna             | 5—Radio & Multicoupler Outlet |
| 3—Lightning Arrester  |                               |

nected and the interference conditions. The length is often as much as 100 ft. and may be 150 ft. or even more. A height of 30 ft. or more above the roof is recommended. Each manufacturer of such a system has developed a special downlead cable which is installed in metal raceway. The downlead is first carried to a tube amplifier and from thence to the outlets. Outlet equipment is the same as for a Type (A) system.

#### 801.2. Specifications

801.2.1. Furnish and install a (trade name or number) radio antenna system including outlets for \_\_\_\_\_ receiving sets, using equipment manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications.

801.2.2. Specify such of the following items as are required for the system selected, also the methods of installation:

- (1) Antenna, Antenna Transformer, (2) Lightning Arrester, (3) Downlead Conductors, (4) Amplifier, (5) Outlets and Set Couplers, and (6) Ground Connections.



## 802. Burglar Alarm Systems

### A. Contacts and Alarms

1. Without control cabinet
2. With control and test cabinet

### B. Contacts, Alarms and Annunciator control cabinet

### C. Contacts, Local Alarms, Annunciator control cabinet and Leased-Wire Alarm Circuits

1. Manual Alarms
2. Automatic Alarms

#### 802.1. Description

A burglar alarm system consists essentially of one or more contact-making devices designed to operate circuits which will actuate one or more alarm devices. These alarm devices may all be located on the premises, or a leased wire connection may be provided to a central office.

Contact devices may be (1) manually operable in an emergency by pushing buttons, tripping the levers of switches, or by depressing hinged contact bars or floor treadles, or (2) automatically operated by means of: Concealed contact-making springs at doors, gates and windows; stair-tread contacts; special locks on doors, cages and vaults; continuous circuits of foil applied to plate glass; or photronic light beams.

Alarm devices may be (1) audible signals, such as gongs, bells, buzzers, horns, sirens, or chimes, of tones that are distinctive of other signals used on the premises, or (2) visual signals. Alarms may be located in several parts of the premises, and on the exterior of the building.

### A. Contacts and Alarms

1. The simplest type of system may employ one or more manual or automatic contact devices of the normally-open type connected in multiple to one or more alarms. The operation of any contact device will actuate an alarm. Such a system requires no relays, and may be operated from dry cell batteries, a transformer, or on 110 volts, provided devices of the correct voltage are selected. This system is not easily tested.

2. Where a system must be kept under daily supervision and must be tested to make sure of its positive functioning, a relay and control cabinet should be provided. The system may then be divided into several circuits. All manual contact devices may be either of the open or closed circuit type and connected to their respective relays in the control cabinet. The automatic contact devices should be of the closed circuit type to facilitate making daily tests of such circuits.

a. The control cabinet may also include a trouble alarm which will give warning of any derangement in the current supply, or in the circuit wiring.

b. A time clock device may be provided in the control cabinet which will automatically disconnect one or more circuits of contact devices, or one or more circuits of alarm devices at a given time of day or night.

c. Control cabinet systems may be operated from batteries, transformers, power units, and in some types of hold-up equipment, on 115-125-volt d.c. or a.c. lighting circuits.

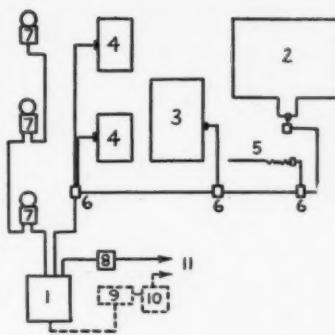
d. The amount of current consumed by such systems is dependent upon the number of alarms employed.

### B. Contacts, Alarms and Annunciator Control Cabinet

This type of system is similar to system A-2 except that the control cabinet includes indicating annunciator drops corresponding with the number of separate circuits that are provided between the control cabinet and the contact devices. This system indicates the location at which a contact device has been operated. This feature is useful in a residence or in large plants or stores.

#### Burglar Alarm System

- 1—Control Panel
- 2—Window Foll (closed circuit)
- 3—Door Jamb Spring Contact (open or closed circuit)
- 4—Window Spring Contact (open or closed circuit)
- 5—Door or Window Mat Contact
- 6—Junction boxes in Raceway System
- 7—Alarm Bells, Gongs or Visual Signals
- 8—Transformer
- 9—Battery instead of No. 8
- 10—Charger for No. 9
- 11—Power Supply



### C. Contacts, Alarms, Annunciator Control and Leased Wire Circuit

This system may incorporate the various features of system A-2 or system B, and may in addition provide relays to operate leased circuits leading to alarms in police stations or patrol agencies.

#### 802.2. Specification

802.2.1. Furnish and install a (give here descriptive designation of the system, manufacturer's name and catalog number) burglar alarm system. This system shall operate on ——— volts.

#### 802.2.2. Conductors

All conductors shall be No. ——— ga., and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

#### 802.2.3. Wiring Methods

All conductors shall be installed in (Name wiring system to be employed). Wiring shall terminate at each outlet for a contact or signal device in an outlet box suitable for the equipment for which the outlet is intended.

Raceway wiring is recommended, excepting that in residences the wiring method may be the same as is employed for other portions of the wiring system.

#### 802.2.4. Equipment

Specify items of equipment as required for the system to be installed.

For systems A-1, A-2, B or C: (1) Window spring contacts (closed circuit type) (open circuit type), (2) list in order other types and makes of contact devices as selected, using the correct catalog number for each, (3) audible signals, (4) visual signals, (5) plate glass foil, (6) dry cell batteries, storage batteries and charger, power unit, or transformer.

Additional items for systems A-2, B or C: (1) Control cabinet (describe special features), (2) photo-electric cell.

For system B: (1) Control cabinet with visual indicator or annunciator (describe special features and state number of circuits).

For system B: (1) Control cabinet as for system B plus relays for leased-wire alarm circuit.

## 803. Electric Clock Systems

The more commonly used electric clock systems are as follows:

- A. Synchronous Motor Clocks With No Central Control.
- B. Synchronous Motor Clocks With Master Resetting Control.
- C. Master and Secondary Clock System.

## Master Specification for Auxiliary Electrical Systems

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- 810. Sound Amplification Systems
- 811. Stage Lighting and Control Equipment
- 812. Private Telephone Systems
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- 814. Watchman System

\* \* \* \*

### 801. Radio Antenna Systems

#### 801.1. Description

For best results in radio reception the antenna system should be one of the following types:

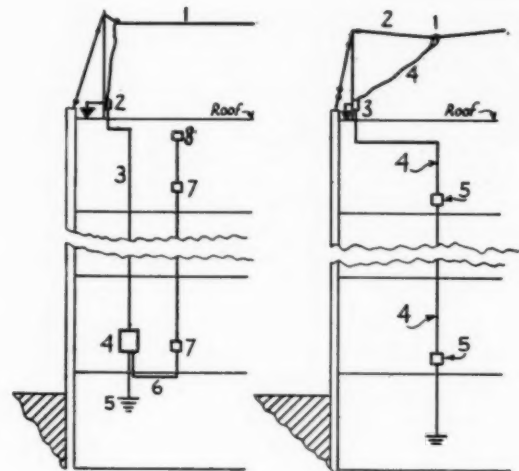
- (A) Doublet antenna with set couplers for all wave reception, for 1 to 25 sets.
- (B) Antenna with amplifier and set couplers for broadcast band reception, for more than 25 sets.

#### Type (A).

The antenna consists of a stranded conductor (7 strands of No. 20 tinned copper or bronze) in two sections insulated from each other. A total length of 60 ft. to 80 ft. is recommended and a clearance of 10 ft. to 15 ft. above a roof, or, if not over a roof, a clearance of at least 30 ft. above the ground. The downlead in a building of wood frame construction may be a No. 18 twisted pair installed in a manner similar to knob-and-tube work, a two-conductor No. 14 armored cable or a No. 18 twisted pair in metal raceway. In fireproof construction the downlead is a No. 18 twisted pair in metal raceway. Each outlet consists of a 4-in. square flush outlet box with 2-gang cover containing a set coupler and provided with a plate, a radio receptacle and a power receptacle.

#### Type (B).

The length and height of the antenna required for this system depends upon the number of receiving sets to be con-



Amplified Antenna System (left)

- |   |  |
|---|--|
| 1—Antenna                                     | 6—Outlet Cable (Downlead Type)                         |
| 2—Antenna Terminal Panel & Lightning Arrester | 7—Radio & Multicoupler Outlet                          |
| 3—Downlead Cable & Raceway                    | 8—Dead - End Corrective Unit (upper end of each stack) |
| 4—Amplifier Panel                             |  |
| 5—System Ground                               |  |

All-Wave Non-Amplified Antenna System (right)

- |                       |                               |
|-----------------------|-------------------------------|
| 1—Antenna Transformer | 4—Downlead Cable              |
| 2—Antenna             | 5—Radio & Multicoupler Outlet |
| 3—Lightning Arrester  |                               |

nected and the interference conditions. The length is often as much as 100 ft. and may be 150 ft. or even more. A height of 30 ft. or more above the roof is recommended. Each manufacturer of such a system has developed a special downlead cable which is installed in metal raceway. The downlead is first carried to a tube amplifier and from thence to the outlets. Outlet equipment is the same as for a Type (A) system.

#### 801.2. Specifications

801.2.1. Furnish and install a (trade name or number) radio antenna system including outlets for \_\_\_\_\_ receiving sets, using equipment manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications.

801.2.2. Specify such of the following items as are required for the system selected, also the methods of installation:

- (1) Antenna, Antenna Transformer, (2) Lightning Arrester, (3) Downlead Conductors, (4) Amplifier, (5) Outlets and Set Couplers, and (6) Ground Connections.

## 802. Burglar Alarm Systems

### A. Contacts and Alarms

1. Without control cabinet
2. With control and test cabinet

### B. Contacts, Alarms and Annunciator control cabinet

### C. Contacts, Local Alarms, Annunciator control cabinet and Leased-Wire Alarm Circuits

1. Manual Alarms
2. Automatic Alarms

#### 802.1. Description

A burglar alarm system consists essentially of one or more contact-making devices designed to operate circuits which will actuate one or more alarm devices. These alarm devices may all be located on the premises, or a leased wire connection may be provided to a central office.

Contact devices may be (1) manually operable in an emergency by pushing buttons, tripping the levers of switches, or by depressing hinged contact bars or floor treadles, or (2) automatically operated by means of: Concealed contact-making springs at doors, gates and windows; stair-tread contacts; special locks on doors, cages and vaults; continuous circuits of foil applied to plate glass; or photronic light beams.

Alarm devices may be (1) audible signals, such as gongs, bells, buzzers, horns, sirens, or chimes, of tones that are distinctive of other signals used on the premises, or (2) visual signals. Alarms may be located in several parts of the premises, and on the exterior of the building.

#### A. Contacts and Alarms

1. The simplest type of system may employ one or more manual or automatic contact devices of the normally-open type connected in multiple to one or more alarms. The operation of any contact device will actuate an alarm. Such a system requires no relays, and may be operated from dry cell batteries, a transformer, or on 110 volts, provided devices of the correct voltage are selected. This system is not easily tested.

2. Where a system must be kept under daily supervision and must be tested to make sure of its positive functioning, a relay and control cabinet should be provided. The system may then be divided into several circuits. All manual contact devices may be either of the open or closed circuit type and connected to their respective relays in the control cabinet. The automatic contact devices should be of the closed circuit type to facilitate making daily tests of such circuits.

a. The control cabinet may also include a trouble alarm which will give warning of any derangement in the current supply, or in the circuit wiring.

b. A time clock device may be provided in the control cabinet which will automatically disconnect one or more circuits of contact devices, or one or more circuits of alarm devices at a given time of day or night.

c. Control cabinet systems may be operated from batteries, transformers, power units, and in some types of hold-up equipment, on 115-125-volt d.c. or a.c. lighting circuits.

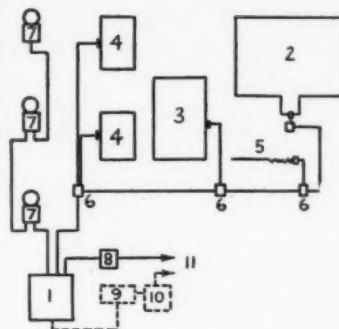
d. The amount of current consumed by such systems is dependent upon the number of alarms employed.

#### B. Contacts, Alarms and Annunciator Control Cabinet

This type of system is similar to system A-2 except that the control cabinet includes indicating annunciator drops corresponding with the number of separate circuits that are provided between the control cabinet and the contact devices. This system indicates the location at which a contact device has been operated. This feature is useful in a residence or in large plants or stores.

#### Burglar Alarm System

- 1—Control Panel
- 2—Window Foil (closed circuit)
- 3—Door Jamb Spring Contact (open or closed circuit)
- 4—Window Spring Contact (open or closed circuit)
- 5—Door or Window Mat Contact
- 6—Junction boxes in Raceway System
- 7—Alarm Bells, Gongs or Visual Signals
- 8—Transformer
- 9—Battery instead of No. 8
- 10—Charger for No. 9
- 11—Power Supply



#### C. Contacts, Alarms, Annunciator Control and Leased Wire Circuit

This system may incorporate the various features of system A-2 or system B, and may in addition provide relays to operate leased circuits leading to alarms in police stations or patrol agencies.

#### 802.2. Specification

802.2.1. Furnish and install a (give here descriptive designation of the system, manufacturer's name and catalog number) burglar alarm system. This system shall operate on — volts.

#### 802.2.2. Conductors

All conductors shall be No. — ga., and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

#### 802.2.3. Wiring Methods

All conductors shall be installed in (Name wiring system to be employed). Wiring shall terminate at each outlet for a contact or signal device in an outlet box suitable for the equipment for which the outlet is intended.

Raceway wiring is recommended, excepting that in residences the wiring method may be the same as is employed for other portions of the wiring system.

#### 802.2.4. Equipment

Specify items of equipment as required for the system to be installed.

For systems A-1, A-2, B or C: (1) Window spring contacts (closed circuit type) (open circuit type), (2) list in order other types and makes of contact devices as selected, using the correct catalog number for each, (3) audible signals, (4) visual signals, (5) plate glass foil, (6) dry cell batteries, storage batteries and charger, power unit, or transformer.

Additional items for systems A-2, B or C: (1) Control cabinet (describe special features), (2) photo-electric cell.

For system B: (1) Control cabinet with visual indicator or annunciator (describe special features and state number of circuits).

For system B: (1) Control cabinet as for system B plus relays for leased-wire alarm circuit.

## 803. Electric Clock Systems

The more commonly used electric clock systems are as follows:

- A. Synchronous Motor Clocks With No Central Control.
- B. Synchronous Motor Clocks With Master Resetting Control.
- C. Master and Secondary Clock System.



## 803.1. Description

## A. Synchronous Motor Clocks With No Central Control

This system consists of synchronous motor clocks connected to 110-115 volt a.c. service. This is a satisfactory system in localities where interruptions of the light and power service are very infrequent. In case any such interruption does occur, each clock must be reset individually. In order to avoid stoppage of clocks because of the blowing of fuses on the general building circuits, it is recommended that special circuits for clocks be specified, not over 25 clock outlets to be wired on one circuit.

## B. Synchronous Motor Clocks With Master Resetting Control

For this system the clocks may be the same as for System A, in which case a frequency changer is provided so that when an interruption of service has occurred, the clocks may be operated at double frequency until they are brought up to the correct time, or each clock may be provided with a dual motor so that the clocks may be speeded up for such time as is necessary to compensate for the interruption. Both methods of regulation may be either manual or automatic. This system is preferable to System A in localities where occasional service interruptions may be expected and where more than six or eight clocks are installed on the same premises. Each clock circuit must be brought back to the central control panel. For dual motor clocks each circuit consists of three wires. Not over 25 clocks should be wired on one circuit. Systems which must be kept in operation during intervals of service interruption can be provided with emergency battery equipment and automatically-controlled motor-generators for temporarily supplying a.c. power to the clocks.

## C. Master and Secondary Clock System

In this system a master clock is employed which is designed to keep accurate time within a few seconds per month. The motive power of the secondary clocks consists of an electromagnet which is energized once per minute or oftener by a circuit-closing device on the master clock, usually through relays on a control panel. An impulse or series of impulses is sent out by the master clock once per hour which brings all secondary clocks into exact synchronism, in case any are slow or fast.

*Time Stamps and Employees' Time Recorders* are clocks equipped with special mechanical devices. They may be synchronous motor clocks or secondary clocks actuated by a master clock. These devices require considerably more power for their operation than simple time-indicating clocks and this must be taken into account when the operation of the device is controlled by a master clock.

The equipment supplied by one manufacturer requires .024 amp., at 24 volts for each secondary clock, and .10 amp. for each time stamp, and the energy taken by equipment of other makes will not vary a great deal from these figures. It is good practice to design secondary clock circuits for loads not exceeding 1.25 amp. per circuit at 24 volts.

## 803.2. Specifications

## 803.2.1. System

Furnish and install a (give here descriptive designation of the system, manufacturer's name and catalog number) clock system including:

- a-1. (System A or B) — clocks
- a-2. (System C) one master clock, (catalog number) and — secondary clocks
- a-3. — time stamps, (catalog number)

- a-4. — employees' time recorders, (catalog number)
- b-1. (System C) storage battery and charging equipment
- b-2. rectifier unit for power supply
- c. (System B or C) control panel (catalog number)

All equipment shall be located as shown on the plans and the entire system shall be installed in conformity with the manufacturer's specifications.

## 803.2.2. Clocks. (Or for System C, Secondary Clocks)

Specify the number required of each size and style of case. Cases may be of wood as desired or of metal with any desired metal finish; round, square or octagonal in shape; flush or surface type.

Dials may be 8 in., 14 in., 16 in., or 18 in., in diameter; of metal or wood, or of glass illuminated from inside the case; with Arabic or Roman numerals.

Clocks shall be mounted at a height of 10 ft. from the floor to the center of the dial, except as otherwise specified and except that the distance from the ceiling to the upper edge of the case shall be not less than 12 in.

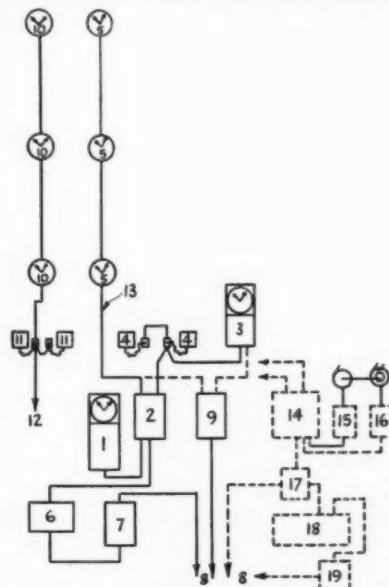
## 803.2.3. Control Panel. (Systems B and C)

Specify manufacturer's name and catalog number.

## 803.2.4. Power Supply. (System C)

a-1. Furnish and install a (name and catalog number) rectifier power supply unit.

a-2. Furnish and install a storage battery consisting of 12 glass jar cells of — ampere-hour capacity each, mounted in a wood tray on a suitable stand, a rectifier capable of



Clock Systems

- 1—Master Clock for secondary clock systems
- 2—Relay Panel for No. 1
- 3—Employees "In & Out" Recorder
- 4—Time Stamps
- 5—Secondary Impulse Clocks, or synchronous - motor clocks with dual resetting motor
- 6—Storage Battery
- 7—Battery Charger
- 8—Normal Power Supply
- 9—Synchronous Clock Automatic Resetting Device (instead of Nos. 1, 2, 6 & 7) when synchron. motor clocks are used
- 10—Synchronous-motor clocks (operated without resetting device, direct on standard branch circuit)
- 11—Time Stamp, same as No. 10
- 12—Power Supply to No. 10 & No. 11 (Use a separate circuit for all clock outlets, isolated from other outlets)
- 13—Clock Circuit Raceway, one or more circuits according to size of system
- 14—Central Control Equipment for Synchronous Clock System
- 15—Controller for Battery-operated Motor-Generator
- 16—Controller for Generator
- 17—Automatic A.C.-D.C. Throwover Switch
- 18—Emergency Battery to Drive M-G Set
- 19—Battery Charger



bringing the battery up from full discharge to full charge in 24 hours, and a charging panel with equipment to automatically cut in the rectifier when the battery voltage drops to 1.8 volts per cell and automatically cut out the rectifier when the battery is fully charged. Storage cells shall be (name and catalog number) and charging panel shall be (name and catalog number).

#### 803.2.5. Wiring

All clocks shall be wired in multiple. Each circuit shall consist of:

- a-1. two conductors (for System A, and for System B except where dual-motor clocks are used).
- a-2. three conductors (for System C, and for System B where dual-motor clocks are used).
- b. Provide a circuit of suitable capacity from the nearest lighting panelboard to the control panel. (For Systems B or C.)

#### 803.2.6. Conductors

All conductors shall be No. 14, and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

#### 803.2.7. Wiring Method

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

## 804. Program Systems

### 804.1. Description

A program system consists of one or more signal devices (bells, buzzers or sirens) and a program instrument which automatically closes a circuit or circuits, causing the signal devices to operate on one or more predetermined schedules.

#### Program Instrument

The program instrument must be driven by a clock mechanism, which may be any one of the three types of clocks described under the heading of Electric Clock Systems. Where clock system C is employed, (See Section 803), the program instrument may be incorporated with the master clock. A program instrument may be designed to actuate each of one or more separate circuits (seldom more than four) on a separate schedule. Each schedule, or program, can be predetermined as desired by means of adjustable contacts. The program instrument can, if desired, be so designed that it can be set to omit all signals during any 6 or 12-hour period, and can be designed to omit all signals on one or more days of each week.

#### Control Panel

A control panel with a relay for each circuit is standard equipment.

#### Signal Devices

The signal devices may be bells, buzzers, gongs or sirens. Bells and gongs are usually of the vibrating type. The signal devices on each circuit are usually connected in multiple, though in some cases series connections may be used. The operating voltage is commonly about 24 volts for d.c. operation and 24 or 110 volts for a.c. operation.

#### Power Supply

For d.c. operation the power supply may be a storage bat-

#### Clock, Program & Signal System

##### Battery-Operated Clocks & Program Device:

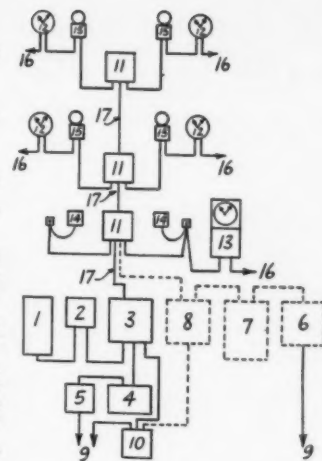
- 1—Master Clock
- 2—Program Device
- 3—Relays & Signal Control Board
- 4—Batteries
- 5—Battery Charger

##### Synchronous Motor Clocks & Program Device:

- 6—Automatic Resetting Device
- 7—Program Clock
- 8—Signal Control Board
- 9—Power Supply (also for No. 5 or No. 10)

##### Clock & Bell Circuiting:

- 10—Signal Transformer, when desired for either system
- 11—Cross-Connecting Terminal Cabinet (other systems may also be included in same enclosure)
- 12—Secondary Impulse, or Synchronous Dual-Motor Clocks
- 13—Employees "In & Out" Recorder
- 14—Time Stamps
- 15—Audible Signals, separate or mounted in clock cases
- 16—Circuits to other outlets



17—One or more raceways, as required for various job conditions

Note: Consult manufacturer for combining signal and clock conductors in common raceways.

tery with automatic charging equipment, or a rectifier unit. For a.c. operation the signal devices may be operated direct from the 115-volt wiring system, or through a signalling transformer.

#### Pushbutton Panel

Where a multi-program system is used, to secure complete flexibility of control one wire from each signal device may be brought back to a pushbutton panel so arranged that any device can be manually operated individually, and by means of cross-connecting straps any device can be connected to operate on any program.

### 804.2. Specifications

#### 804.2.1. General

Furnish and install a complete program system consisting of the equipment specified below and all wiring and devices necessary for the satisfactory operation of the system.

#### 804.2.2. Program Instrument

The program instrument shall be of (manufacturer's name) make, catalog No. ...., and shall be of the

- a-1. single-program
- a-2. ....-program

type. The program instrument shall be so arranged that it can be set to omit all signals during any period.

- b. and to omit all signals during any one or two days of each week.

- c-1. The program instrument shall be operated by a (specify here the type of clock to be employed, as synchronous motor clock, dual synchronous motor clock, or secondary clock. If to be a secondary clock, specify the type of master clock.) (See Section 803).

- c-2. The program instrument shall be incorporated with the master clock specified in Section .....

#### 804.2.3. Control Panel

Provide a (manufacturer's name and catalog number) control panel with relays for operation of ..... circuits to signal devices.

**804.2.4. Pushbutton Panel: (Optional)**

Provide a (manufacturer's name and catalog number) pushbutton panel equipped with ..... pushbuttons for individual operation of the signal devices and with busbars and cross-connecting straps so arranged that any signal device can be connected to operate on any one of the ..... programs.

**804.2.5. Power Supply**

Specify for d.c. operation a ..... volt storage battery with automatic charging equipment, or a rectifier unit to deliver ..... volts; for a.c. operation, a signaling transformer of suitable wattage and voltage, or direct operation from the 115-volt wiring system.

**804.2.6. Signal Devices**

Specify the number of each size and type of buzzers, bells, gongs and horns and their locations, giving the manufacturer's name and catalog numbers.

**804.2.7. Wiring**

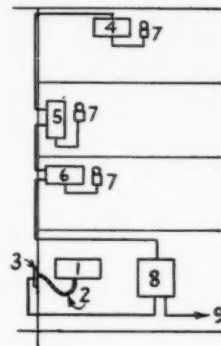
Wiring shall be installed in accordance with the program bell wiring diagram, Drawing No. .... (A complete diagram should be prepared, showing all raceway sizes and the number and size of wires in each run.)

**804.2.8. Conductors**

All conductors shall be No. .... ga., and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

**804.2.9. Wiring Method**

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

**Doctors Paging System**

- 1—Selector Switch Panel at or near Telephone Switchboard
- 2—Flexible Cable for No. 1
- 3—Wall Junction Box
- 4—Recessed or Ceiling-Suspended Annunciator
- 5—Wall-Projecting Edge-wise Annunciator
- 6—Wall-Projecting Endwise Annunciator
- 7—Audible Signal Optional, Mounted Integral or Separate Buzzer, Bell or Chime
- 8—Lamp Flasher Relay Panel
- 9—Power Supply

is limited to simultaneous paging of three doctors as a general maximum. The equipment is essentially the same as for system B-1, except that more conductors are required.

Systems B-1 and B-2 usually employ a mobile selector keyboard and flexible multi-conductor cable connections to a fixed floor or wall outlet. Raceways are provided from the fixed outlet to a flasher and relay cabinet. The various circuit raceways are routed from the relay cabinet to all annunciators. In buildings which require several annunciators per floor, as at wings, a system of terminal cabinets may be found desirable for routing runs that lead away from a central riser point. These systems are commonly operated on 110 volts.

**C. In-and-Out Recorders**

This system is identical in principle and design to system A except that no audible signal is employed. Its purpose is to provide a lamp annunciator at one or more locations in a hospital to indicate the presence of certain staff doctors. The plugging or switching device may be portable or fixed and should be located at the most convenient place for doctors to "check" in and out, otherwise at the telephone switchboard. Because certain doctors are present for extended periods of time, thus requiring their lamps in the various annunciators to be left on for a like period, the type of lamps and their operating voltage should be selected to assure maximum life.

**805.2. Specifications**

**805.2.1. Furnish and install for doctors' paging system a** (trade name or number) (insert, A, B-1, B-2, and/or C system designation) as indicated on wiring plans, as manufactured by (name of manufacturer) all of which shall be installed in accordance with manufacturer's specifications. This system shall operate on ..... volts.

**805.2.2. Conductors**

All conductors shall be No. .... ga., and shall have 600-volt insulation of a type suited to the locations and conditions. They shall be of the make and grade as elsewhere specified.

**805.2.3. Wiring Method**

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

**805.2.4. Equipment**

Specify items of equipment as required for the system to be installed.

- (1) Annunciators, with or without audible signals; (2) Selector keyboard; (3) Plugging or switching device; (4) Relay and flashing panel; (5) Terminal cabinet; (6) Flexible multi-conductor control cable; (7) Transformer; and (8) Special outlet boxes.

**805. Doctors' Paging Systems**

- A. Lamp Annunciators
- B. Lamp Flashing Signals
  - 1. Single-Call Type
  - 2. Multi-Call Type
- C. In-and-Out Recorders

**805.1. Description****A. Lamp Annunciators**

This is a simple system of lamp annunciators located on various floors operated from a fixed or portable plugging or switching device at the telephone switchboard. The quantity of numbered lamps and switch keys is governed by the size of the hospital staff. Such systems may include an audible auxiliary signalling device, and may be operated from a signal transformer or on 110 volts. Lamps must be flashed on and off manually.

**B. Lamp Flashing Signals****1. Single-call Type.**

This system is designed for paging one doctor at a time from the telephone switchboard room or other central location. One or more lamp annunciators, arranged with or without auxiliary audible signals, are provided with indicating numerals. The annunciators are controlled by a central keyboard and flasher equipment. Numerals as are assigned will provide for the individual paging of a staff of 120 doctors. The lamps are flashed automatically for a definite time cycle or until the doctor responds.

**2. Multi-call Flashing Signals.**

This system is designed for a total staff of 120 doctors, and

## 806. Emergency Lighting Systems

- A. Two or more independent sources of current supply  
 B. Auxiliary current supply  
 1. Automatically charged batteries  
 2. Automatically started generators  
 3. Small non-compulsory emergency battery systems

### 806.1. Description

Emergency lighting systems are required by state laws, municipal ordinances, and by the National Electrical Code. While these requirements apply generally to theatres, moving picture shows, and other public gathering places, some states and cities have regulations which stipulate additional occupancies for which emergency lights must be provided, such as hotels, schools, factories, etc.

Emergency lights must be kept lighted during definite periods of occupancy or building use, and in case of failure in the normal current supply, must be automatically transferred without appreciable delay to an emergency source of current. The emergency lighting system must be capable of lighting for a specified period of normal current supply failure all exit signs, and also provide sufficient illumination to enable persons to leave a building safely.

In many local or state regulations, the number, location and wattages of lighting outlets are prescribed, also the types and the ampere-hour or full-load capacity of auxiliary emergency systems are set forth, stating the minimum voltages that may be applied to standard lamps.

Specifications for equipment and wiring layouts for emergency lighting systems should therefore be checked in detail with the inspection authorities having jurisdiction.

#### A. Two or more independent sources of current supply

Where two or more separate and complete systems with independent current supply can be installed, each of these systems may supply a part of the emergency lighting provided all emergency lights supplied on each independent current supply system are kept lighted. The several supply systems may also serve all or a part of the general house lighting system.

Unless all the emergency lights served by two or more independent supply systems are kept lighted, a throwover switch must be provided which will automatically transfer the emergency lighting system from the normal to the emergency service in case of current failure.

#### B. Auxiliary current supply

B-1. Auxiliary storage batteries of approved type and capacity may be provided instead of, or in addition to, System A. These batteries must also be provided with an automatic throwover switch, and they must further be automatically maintained at a fixed minimum state of charge. These systems normally operate at 105 to 120 volts.

B-2. Auxiliary generators with prime movers may be used in lieu of B-1, provided they are equipped with automatic controllers, and are capable of generating the energy required for the full emergency load within a certain reasonable time limit after a current failure occurs.

a. Prime movers for driving auxiliary generators must be automatically started and may be

- a-1. internal combustion engines,
- a-2. steam driven engines,
- a-3. steam or water driven turbines.

b. Automatic controllers must include approved storage batteries of the correct capacity for cranking one or more of the foregoing types of engines, or for operating the engine supply valves, as the case may be. When cranking batteries are employed, approved automatic charging devices

must be provided for them. These generators commonly operate at 110 to 115 volts.

c. Automatic throwover switches, as called for in System A must also be provided for System B-2.

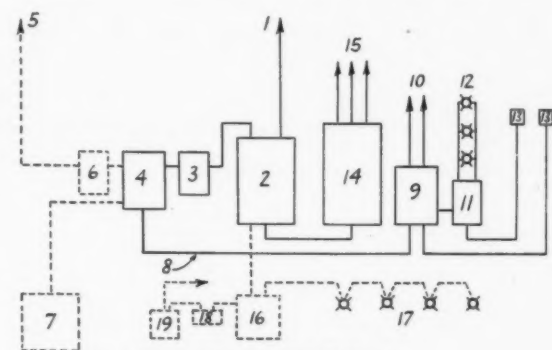
d. Auxiliary generators are sometimes permitted to be installed with sufficient capacity to supply all or part of the general lighting system, as well as the emergency lighting outlets prescribed by regulations.

B-1 and B-2. Approved warning or derangement signal devices of the audible or visual types must be provided for systems B-1 and B-2. These signals shall automatically give warning of a derangement of the emergency current sources, and shall indicate when batteries or a generator set are carrying the emergency illumination load.

B-3. Small emergency lighting systems are used voluntarily in banks, stores, factories and other places that are not required to provide emergency lighting systems. These systems are designed to supply through a storage battery a small number of specially-equipped lighting units located in several important areas. A separate circuit is run from an automatic battery control panel to these lighting units. This circuit has no electrical connection with other normally supplied circuits. The automatic control panel usually consists of an automatic battery charging device and an automatic switch or relay for turning on the auxiliary lighting circuit whenever there is a failure in normal energy supply. A power supply connection must be provided between the control panel and the normal supply system for the throwover relay and for the battery charger. These systems usually operate at from 10 to 32 volts.

### 806.2. Installation

a. All conductors for systems A, B-1 and B-2 are required



Emergency Lighting Systems

- 1—Main Service Conductors
- 2—Main Service Equipment
- 3—Emergency Service Equipment (connected ahead of No. 2)
- 4—Automatic Throwover Switch to transfer from No. 1 supply to Emergency Supply
- 5—Independent Supply for Emergency Service
- 6—Service Equipment for No. 5
- 7—Auxiliary Emergency Service supply (instead of No. 5) storage battery system or automatically controlled generator
- 8—Feeder to Emergency lights
- 9—Lighting Branch Circuit Panelboard for Exit lights and other constant-use outlets of the emergency system
- 10—Branch Circuits to various outlets
- 11—Lighting Branch Circuit Panelboards for emergency outlets used only at night
- 12—Night-only Outlets
- 13—Remote-Control Stations for operating master remote control switches in No. 9 and No. 11
- 14—Main Feeder Distribution Center
- 15—Sub-Feeders to General Panelboards
- 16—Auxiliary lighting system for occupancies not required to use Emergency Systems No. 5 or No. 7. For operating a small number of separately-wired lighting outlets. This system includes an integral automatic throwover to switch on outlets No. 17 when main supply No. 1 fails.
- 17—Battery-operated Lighting outlets (usually 10 to 32 volts)
- 18—Battery
- 19—Battery Charger



to be installed in metal raceways or armored cable. No conductors of other feeders or branch circuit wiring shall be installed in the same raceways, outlet boxes, wireways or cabinets supplying the emergency lighting systems.

b. The service equipment for emergency lighting systems must be so connected that it will not be interrupted by the disconnecting of normal service equipment devices or by the functioning of normal service equipment over-current devices, except for the momentary delay while automatic throw-over devices are functioning. Only the emergency service over-current devices shall be placed ahead of the emergency branch circuit over-current protective devices.

c. The switch for turning emergency lighting circuits "on" or "off" at the opening or closing of a theatre or other occupancy must, except as provided in paragraph d, be limited to one switch accessible only to authorized persons. This switch should preferably be located in the lobby or other place convenient to the main entrance of the building. This requirement will usually necessitate the installation of an emergency lighting panelboard that contains a remote-controlled master switch. A remote-control switch designed to operate this master switch can thus be placed in the lobby to meet the foregoing requirement. When the emergency lighting system only requires one to three branch circuits, a single or multi-pole switch can be provided in the lobby for directly controlling the several circuits. A feeder control switch for manually switching a group of emergency circuits from the lobby, is not recommended, and in most cases requires a considerable increase in the length of the feeder conductors and raceway.

d. It is permissible to provide a separate switch for controlling one or more circuits supplying exterior emergency lights that are only needed during periods when there is not sufficient daylight. An automatic light-actuated control device may be used for this purpose.

e. For further installation details regarding systems A, B-1 and B-2, see Articles 36 and 41 of the National Electrical Code.

System B-3 may involve runs of considerable length to scattered outlets. When low-voltage auxiliary batteries are used, the conductors should be of adequate size to avoid excessive voltage losses and to prevent a corresponding reduction of illumination intensity.

### 806.3. Specifications

806.3.1. Furnish and install an emergency lighting system complete with equipment and all service and branch circuit wiring to emergency outlets as indicated on the wiring plans. This equipment shall be as manufactured by ..... and shall be installed and connected in accordance with the manufacturer's specifications.

### 806.3.2. Conductors

All conductors shall be of sizes indicated on the wiring plans and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

### 806.3.3. Wiring Method

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

### 806.3.4. Equipment

Specify items of equipment as required for the system to be installed.

For System A, B-1 or B-2 (1) Automatic throwover switch, (2) Lobby control device or devices.

For System B-1 (1) Storage batteries, (2) Automatic battery charger, (3) Derangement signals.

For System B-2 (1) Generator and prime mover, (2) Automatic controller, (3) Cranking storage batteries, (4) Automatic battery charger, (5) Automatic valves, (6) Derangement signals.

For System B-3 (1) Automatic Battery control, charging and relay panel, (2) Storage batteries, (3) Separate high-intensity low-voltage emergency lighting units, (4) separate low-voltage branch circuit.

## 807. Fire Alarm Systems

- A. Open-circuit, Non-code, Non-supervised
- B. Closed-circuit, Non-code, Supervised
- C. Closed-circuit, Box Code, Supervised
- D. Closed-circuit, Pre-signal, Box Code, Supervised
- E. Closed-circuit, Box Code, Supervised System With Connection to Fire Department
- F. Automatic

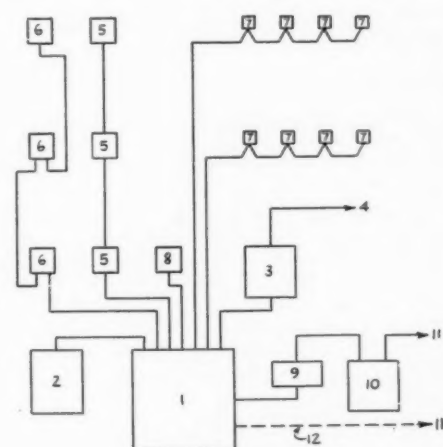
### 807.1. Description

#### A. Open-circuit, Non-code, Non-supervised System

When any station is operated, a general non-coded alarm is sounded on all gongs. This system is open to the objection of all open-circuit systems that if through failure of the power supply or for other reason the system becomes inoperative, there is no means of ascertaining this condition other than by making a test at each station, i.e., it is inherently a non-supervised system. It is not recognized by the National Board of Fire Underwriters as an "approved" system. Only a small number of alarm devices can be operated on this system without a relay control panel. If the number of devices on the system is such as to require a control panel, a closed-circuit system should be specified as the cost will be only a very little greater.

#### B. Closed-circuit, Non-code, Supervised System

Operation of any station sounds a general alarm six times on all gongs. If there is a failure of the power supply or the circuit is opened at any point, a small trouble bell rings continuously. This system is much more dependable than a non-supervised open-circuit system. It is suitable for use in



Fire Alarm System

- 1—Control Panel
- 2—Master Alarm Station
- 3—Fire Dep't. Alarm Box
- 4—Connection to Fire Dep't. System.
- 5—Alarm Stations
- 6—Alarm Devices
- 7—Thermal Detectors
- 8—Trouble Bell
- 9—Batteries
- 10—Battery Charger
- 11—Power Supply
- 12—Power Supply direct instead of No. 9 and No. 10



buildings where there will not be so many occupants that a general alarm may cause a panic.

#### C. Closed-circuit, Box-Code, Supervised System

When any station is operated, a coded signal identifying that particular station is sounded on all gongs, usually four times in succession. Being a closed-circuit supervised system it provides the maximum of dependability and is suitable for any building where there is an advantage in having a coded signal and where there is no objection to sounding a general alarm whenever a station is operated. The gong circuits are usually operated through relays on a central control panel. Disarrangement of the system is indicated by a trouble bell, as in System B.

#### D. Closed-circuit, Box Code, Pre-signal Supervised System

In this system the operation of any station sends a coded signal through a relay control panel to one or more pre-signal bells; these may be installed at any desired locations. It is then the duty of an attendant to make an investigation and, if necessary, turn in a general alarm. The general alarm may be turned in from any alarm box by inserting a key. A trouble bell is provided as in Systems B and C. This system is suitable for hospitals, hotels, department stores, institutions, places of public assembly and other buildings where it is not advisable to sound a general alarm until an investigation has been made and such action found necessary.

A pre-signal system may also include a relay to operate a special fire department alarm box.

#### E. Closed-circuit, Box Code, Supervised System With Connection to Fire Department System

This system is the same as System C with the addition of a relay on the control panel connected to a special fire department alarm box. Operation of any station sounds a coded signal on all gongs and at the same time sends an alarm on the municipal fire department alarm system. By inserting a key in any box the station can be operated for fire drills without operating the fire department system.

#### F. Automatic Fire Alarm System

In the automatic fire alarm system, thermal detectors are installed at suitable locations, usually on the ceilings of the spaces to be protected. When the temperature at any device exceeds a predetermined limit, the circuit is opened and an alarm is sounded through a control panel. Reliable systems of this type are closed-circuit and supervised.

#### 807.2. Wiring Data

Wiring data applying to typical fire alarm systems are given in the following table:

WIRING DATA FOR FIRE ALARM SYSTEMS					
System	Station Connection	Gong Connection	Siren Connection	Size Wire Gage No.	No. of Wires
A. Open-circuit, non-code	Multiple	Multiple	Multiple	14	2
B. Closed-circuit, non-code	Multiple	Series	Series	14	2
C. Closed-circuit, box code	Series	Series	Series	14	2
D. Closed-circuit, pre-signal	Series	Series	Series	14	4
E. Closed-circuit, connected to fire department system	Series	Series	Series	14	2
F. Automatic	Series	Series	Series	14	2

### 807.3. Specifications

#### 807.3.1. System

Furnish and install a (give here the descriptive designation of the system, manufacturer's name and catalog number) fire alarm system including ..... alarm stations and ..... alarm devices located as shown on the plans. The system is to be operated on 110-120 volts a.c. All equipment except standard wiring materials shall be the product of (name of manufacturer). The entire system shall be installed in conformity with the manufacturer's specifications.

#### 807.3.2. Conductors

All conductors shall be No. 14, and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

#### 807.3.3. Wiring Method

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet for an alarm station or alarm device in an outlet box suitable for the equipment for which the outlet is intended.

#### 807.3.4. Equipment

Specify items of equipment as required for the system to be installed:

##### Alarm Stations:

Systems A, B—Hammer type break-glass station, flush or surface type. Hammerless type break-glass station, flush or surface type, maximum 20 per circuit.

Systems C, D, E—Open-door pull-lever type, semi-flush or surface; break-glass pull-lever type, semi-flush or surface. Specify that all alarm stations shall be mounted 4 ft. 6 in. above the finished floor, maximum 20 per circuit.

##### Special Fire Department Alarm Box:

Required for System E and may also be added to System D.

##### Alarm Devices:

System A—Vibrating gongs, 8 in., 10 in. or 12 in., maximum 15 per circuit. Sirens—maximum 10 per circuit.

Systems B, C, D, E, F—Single-stroke gongs, 8 in., 10 in., or 12 in., 10 per circuit. Sirens—maximum 10 per circuit.

In general, gongs and sirens should be mounted 12 ft. above the finished floor or as near this height as the ceiling height will permit.

##### Control Panel:

Required for all systems except A systems having only a small number of alarm devices.

##### Trouble Bell:

Required for all supervised systems, B, C, D, E, F. Specify 3 in. or 4 in.

##### Thermal Detectors:

Required for System F. Specify manufacturer's name and catalog number, spaces to be so equipped, maximum allowable spacing between outlets and maximum number of outlets to be wired on one circuit.

## 808. General Paging System

#### A. Central Manual Signalling

1. To one or more outlying signals operating simultaneously
2. To one or more outlying signals, operated individually or in sub-divided groups

#### B. Central Mechanical-Code Calling

1. To several outlying signals operating simultaneously
2. To several outlying signals operated individually or in sub-divided groups.

#### 808.1. Description

##### A. Central Manual Signalling

This system is fundamentally an arrangement of one or

more push buttons for controlling signalling circuits leading to audible or visual signals located in outlying rooms or areas. With system A-1 the signalling procedure would require a predetermined code for paging one of two or more persons from any part of a building. With system A-2 the same procedure would usually be followed, excepting that the operation of signals could be limited to sub-divided portions of large buildings as desired.

#### B. Central Mechanical-Code Signalling

This system is used for transmitting a predetermined series of signalling impulses to several locations over a sustained period of time by means of mechanical devices. Coded signals are transmitted without further attention until the paged person responds, or until the transmitter is stopped, or until it has completed a definite cycle of impulse transmittance. Signal impulses may be transmitted simultaneously to all stations as in B-1, or to sub-divided portions of large buildings as in B-2.

A transmitter unit is usually placed near the telephone switchboard operator. This transmitter may be a selector keyboard for operating a separate set of relays, or it may be a mechanically driven device for the direct switching of coded impulses without using relays.

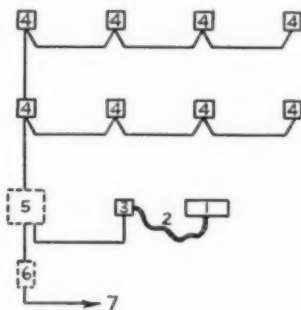
Signal devices for A or B systems may be bells, buzzers, chimes, gongs, horns, howlers, sirens, whistles or visual types, provided such devices are selected to operate efficiently on the impulses transmitted by the equipment chosen. Large sirens, and large air valve whistles operating at 110 or 220 volts require special relays especially if low-voltage paging impulse equipment is used. When B-1 or B-2 systems are operated from transformers, a separate 110-volt connection must be provided for some makes of selector relays and motor drives.

#### 808.2. Installation

Provide two conductors from the signalling location to all signal devices of system A-1. Add one conductor for each sub-division of signal devices as in system A-2. Provide conductors between the selector relays and the signal devices of systems B-1 and B-2 as called for under systems A-1 and A-2 above. The number of conductors to be provided between selector keyboards and relay cabinets shall be determined from the manufacturer's system wiring diagram.

#### 808.3. Specification

808.3.1. Furnish and install a (trade name or number) gen-



General Paging System

- 1—Mobile Transmitter Device & Flexible Cable
- 2—Flexible Cable for No. 1
- 3—Wall Outlet for Cable Connection
- 4—Gongs, Chimes, Horns, Whistles & Other Audible or Visual Signals
- 5—Relay & Selector Panel if used
- 6—Transformer for a.c. systems below 110 Volts
- 7—Power Supply

eral paging system as indicated on wiring plans, as manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications.

#### 808.3.2. Conductors

All conductors for 110-volt systems shall be not less than No. 14. They shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

#### 808.3.3 Wiring Methods

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed.) Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

#### 808.3.4. Equipment

Specify such of the following items as are required for the system selected:

- (1) Selector; (2) Selector relay panel; (3) (Non-relay type) Impulse transmitting device; (4) Flexible cable; (5) Transformer; (6) Audible signals; (7) Visual signals; (8) Special relays (for large signal devices); and (9) Special outlet boxes or cabinets.

### 809. Nurses' Calling System

- A. Magnetic-Drop Annunciators
- B. Lamp Annunciator Systems
- C. Nurse-Patient Talking Systems

#### 809.1. Description

##### A. Magnetic-Drop Annunciator Systems.

This system is suitable for use in hospitals comprising a small number of rooms. Patients may operate a signalling button or switch to energize a corresponding drop on an annunciator located at the nurses' station. Audible signals may be included at the annunciator, but lamp signals are not recommended to be combined with such systems.

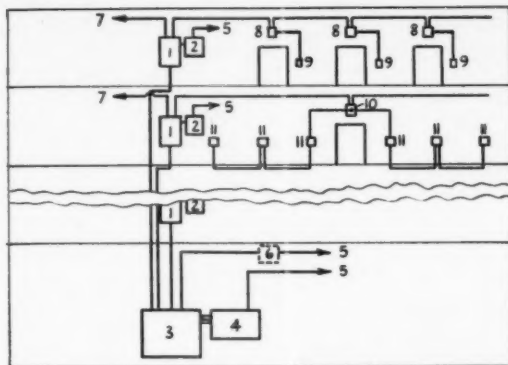
##### B. Lamp Annunciator Systems.

This system is used in hospitals of all sizes. Patients' calling stations are provided for turning on lamp signals and auxiliary audible signals in one or more lamp annunciators. Calling stations may consist of flexible cords and push buttons, cord-pull lever switches, wall switches, or wall push buttons. Patients' calling stations in wards may include bull's-eye pilot lamps to indicate which of two or more patients in one ward have called for a nurse. Lamp signal domes are provided in the corridors above the entrance to each room or ward. When turned "on" by a patient, the corridor and annunciator lamp signals usually remain "on" until turned off by a nurse at the patient's calling station. Audible auxiliary signals are usually of short duration.

Annunciators are provided at nurses' stations equipped with numbered lamp lenses or luminous cover plates to correspond with the number of calling stations provided in the wing or area served by a particular nurses' station. Additional annunciators may be added in diet kitchens or other areas. A master annunciator may also be included in the supervising nurse's office to indicate all calls.

A master recording device, or separate devices at each nurse's station, may be included to provide an individual chart record of the elapsed time between patients' calls and the nurses' arrival at the patients' calling stations.

Additional signalling facilities may be provided in one or more rooms by which a nurse or patient may operate an auxiliary calling station to indicate an emergency signal.



Nurses' Calling System

- |   |  |
|---|--|
| 1—Nurses Station Annun-<br>ciator                                 | 6—Signal Transformer (for<br>Low-Tension Systems)                      |
| 2—Elapsed time Recorders<br>(when Master Recorder is<br>not used) | 7—Power Supply at each<br>Floor for large systems,<br>instead of No. 5 |
| 3—Master Annunciator (Sup't.<br>Office)                           | 8—Corridor Signal Dome   |
| 4—Master Elapsed Time<br>Recorder (instead of No.<br>2)           | 9—Patients Calling Station   |
| 5—Power Supply  | 10—Ward Entrance Corridor<br>Signal Dome                               |
|   | 11—Patients Calling & Pilot<br>Lamp Station for Wards                  |

Such emergency signals may be separate lamps of a distinctive color, in corridor domes or in annunciators. These signals may also include auxiliary audible signals of a distinctive tone.

#### C. Nurse-Patient Talking Systems.

This system employs fixed or portable microphones and speakers for patients to establish voice communication with their nurses' station. The nurses' station equipment consists of a terminal cabinet, an annunciator and a keyboard control unit for switching a patient's conversation to a nurse's microphone and speaker instrument. This system may be operated independently of, or in conjunction with a modification of system B.

#### 809.2. Installation

System A is designed primarily to be operated at low voltages by a signalling transformer. System B is available in 110-V. and low-voltage types. System C may be designed for combinations of 110-V. and low-voltage.

#### 809.3. Specifications

809.3.1. Furnish and install a (trade name or number) nurses' calling system as indicated on wiring plans, as manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications. This system shall operate on ..... volts.

#### 809.3.2 Conductors.

All conductors shall be No. .... ga., and shall have 600-volt insulation of a type suitable to the locations and the conditions. They shall be of the make and grade as elsewhere specified.

#### 809.3.3. Wiring Methods.

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

#### 809.3.4. Equipment.

Specify items of equipment as required for the system to be installed.

- (1) Patient's room calling stations; (2) Patient's ward calling

stations; (3) Patient's emergency calling stations; (4) Patient's microphone and speaker stations; (5) Nurses' station sound amplification equipment; (6) Nurses' station, diet kitchen, or master annunciators; (7) Elapsed time recorders; (8) Corridor domes; (9) Signal lamps; (10) Audible signals; (11) Transformers; (12) Terminal Cabinets; (13) Special cables; and (14) Special outlet boxes.

## 810. Sound Amplification Systems

### 810.1. Description

#### A. Elementary System

A sound amplification system in its simplest form consists of three parts:

- (1) An input device for supplying energy at audio frequencies to the amplifier,
- (2) An audio-frequency amplifier,
- (3) One or more devices to transform the audio-frequency energy into sound, commonly termed "speakers."

The primary device providing the input to the amplifier may be either:

- a. A microphone, used for picking up sound vibrations, usually voice (talking or singing) or instrumental music.
- b. A record reproducer. The record is most commonly in the form of a disc and the equipment is usually termed a phonograph. ("Sound-on-film" equipment is used almost universally in motion-picture work but is seldom employed in conjunction with other sound amplification systems.)
- c. A radio receiving set.

The more important characteristics of the amplifier are its output capacity, rated in watts, and its fidelity. High fidelity involves freedom from objectional distortion and uniform amplification of all audio frequencies within reasonable limits.

Uniform amplification of all frequencies between 30 and 10,000 cycles per second is usually considered excellent performance. The necessary watts output of the amplifier depends upon the number and type of speakers to be supplied.

Speakers are of three types, known as "magnetic," "electrodynamic" and "permanent magnet dynamic."

Magnetic speakers, as compared with the other types, have lower power consumption, lower sound output and a lower degree of fidelity. They are usually preferred where a considerable number of speakers must be operated from one amplifier and high output and high fidelity are not considered necessary. All speakers operated from one amplifier are connected in multiple on one pair of wires. Where speakers are installed in separate rooms it may be necessary to provide an individual volume control for each speaker.

Electrodynamic speakers are used where a sufficiently high output cannot be obtained from magnetic speakers and where high fidelity is important. All speakers operated from one amplifier are connected in multiple and individual volume controls should usually be provided where speakers are in separate rooms. Provision must also be made for current supply to the field winding of each speaker; this field current may in some cases be supplied from the amplifier, or it may be necessary to provide for each speaker or for a group of speakers a power supply unit with a connection to the 110-volt wiring system.

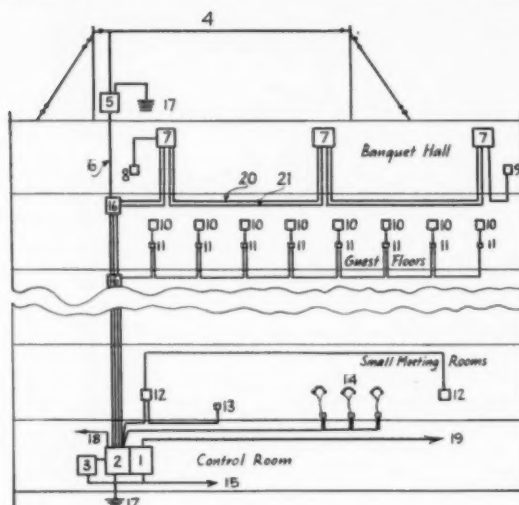
Permanent magnet dynamic speakers have the same characteristics as the electrodynamic type as regards fidelity and sound output but no provision is required for field excitation current.

The simple type of sound amplification system having one or more input devices, a single amplifier and one or more speakers, has innumerable applications.

#### B. Multi-channel System

A multi-channel system consists of a combination of two or



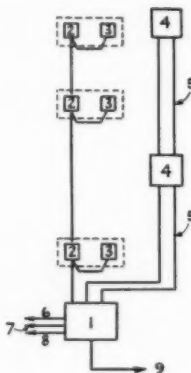


Sound Amplification System

- |   |                                 |
|---|---------------------------------|
| 1—Receivers & Controls                          | 15—Power Supply                 |
| 2—Amplifier Panels                              | 16—Terminal Cabinet             |
| 3—Phonograph                                    | 17—Grounds                      |
| 4—Antenna                                       | 18—Inter-Comm. Telephone Tie-in |
| 5—Antenna Terminal Panel and Lightning Arrestor | 19—Public Tel. Circuits         |
| 6—Downlead Cable                                | 20—Loudspeaker Circuit          |
| 7—Heavy-Duty Loud Speakers                      | 21—Heavy Speaker Power          |
| 8—Speaker Control                               |                                 |
| 9—Microphone                                    |                                 |
| 10—Room Speaker                                 |                                 |
| 11—Channel Selector & Volume Control            |                                 |
| 12—Microphone & Speaker Outlet                  |                                 |
| 13—Microphone Outlet                            |                                 |
| 14—Head Sets for Deaf Persons                   |                                 |

Small Sound Amplification System (right)

- 1—Amplifier
- 2—Magnetic Speaker
- 3—Microphone (May be integral with No. 2)
- 4—Electro-Dynamic Speakers
- 5—Power Supply to No. 4
- 6—Radio Input
- 7—Telephone Circuit
- 8—Microphone Connection (Portable Units)
- 9—Power Supply



more elementary systems, permitting two or more programs to be transmitted to each speaker station. A selector switch is provided at each speaker for selecting the desired program. As an example, a four-channel system might provide for reception from two different radio broadcasting stations, a program of addresses being delivered at a local meeting and received through a microphone, and a program reproduced from phonograph records. Multi-channel systems are quite commonly used in large hotels.

### 810.2. Control Panel

For a very simple system with a single amplifier, all equipment and controls may be mounted in cabinet form. For larger systems, particularly where a radio receiving set is used, and for a multi-channel system in practically all cases, the equipment and controls are mounted in panel form.

### 810.3. Wiring

From a microphone outlet to the control panel a special

shielded pair is required, whether installed in metal raceway or otherwise.

From the control panel to speaker outlets, twisted pairs in metal raceway are used for single-channel systems but for a high-output multi-channel system shielded pairs may be necessary if pairs for two or more channels are run in one raceway. Speaker field circuit wires should have 600-volt insulation and should not be run in the same raceway as the output circuit from the amplifier.

### 810.4. Specifications

#### 810.4.1. Furnish and install a complete

- a-1. single-channel
- a-2. ——— channel

sound amplification system. All special equipment shall be the product of (name of manufacturer) and the entire system shall be installed in conformity with the manufacturer's specifications. The location of all equipment except speakers is shown on the plans.

#### 810.4.2. Speakers

Furnish and install speakers as specified below. The contractor shall consult the manufacturer regarding the exact location of the speaker or speakers in each room and shall install this equipment at the locations specified by the manufacturer.

One No. — magnetic speaker to be installed in each of the following rooms:

— No. — electrodynamic speakers to be installed in the —.

— No. — permanent magnet dynamic speakers to be installed in the —.

#### 810.4.3. Raceways

All conductors shall be installed in metal raceways. Raceways shall terminate at each outlet in an outlet box suitable for the equipment to be provided.

#### 810.4.4. Equipment

Specify such of the following items as are required, giving in each case the manufacturer's catalog number:

- Control panel, to include
- Radio receiving set
- Amplifiers
- Phonograph turntable and pickup
- Horns
- Microphones and stands
- Microphone outlet devices
- Shielded conductors for leads to microphone outlets and speaker outlets.

## 811. Stage Lighting and Control Equipment

### 811.1. Equipment

The following data and specifications are intended to apply only to the stages found in school auditoriums, lodge halls and other assembly halls of small or medium size. Much more elaborate equipment is required in commercial theatres and large auditoriums.

*Permanent Lighting Equipment* consists of footlights and borderlights. Both footlights and borderlights are arranged to produce illumination in either white, red or blue or any desired combination of these colors, the total number of lamps being equally divided between the three colors. The better class of equipment is provided with an individual reflector for each lamp, the reflector being fitted with a lens of clear or colored glass termed a "roundel." As compared with the open trough construction and dip-colored lamps formerly used, the individual reflector type is far more efficient and has a much lower maintenance cost. The length of footlights



and borderlights should be about 5 ft. less than the width of the proscenium opening.

### Footlights

Unless otherwise specified, a footlight is understood to be of the type that is permanently fixed in position. Disappearing footlights are desirable in school and lodge hall auditoriums and other halls where the stage is often used as a lecture platform. When not in use, a hinged cover folds down to cover the opening in the floor and at the same time the footlight is automatically lowered and the supply circuits are opened by a switch. Disappearing footlights are regularly made in sections 5 ft. long.

Lamps are spaced approximately 6 in. on centers. A single row of 100-watt lamps is recommended as a minimum. For better lighting, one row of 150-watt lamps may be used, or two rows of 100-watt lamps.

### Borderlights

The first borderlight should be located about 2 ft. from the proscenium arch, or as near this position as possible without interfering with other equipment. If two or more borders are installed, the spacing measured on a line from front to back of stage should be about 6 ft. on centers. One borderlight is usually sufficient for a stage 14 ft. deep or less. Two should be provided for depths up to 20 ft., three up to 26 ft. and four up to 32 ft. When the full depth of a stage is to be utilized for scenery, one additional border may be needed in each of the above cases. It is recommended that 100-watt lamps be used as a minimum, with 150-watt or 200-watt lamps for higher lighting intensities. The spacing should be approximately 6 in. on centers for 100 or 150-watt lamps and 8 in. for 200-watts. For installations including two or more borders, one or two independently controlled lamps for use as working lights should be included in at least one of the borders.

All borderlights should be so hung that the angle of light throw (downward and toward the back of the stage) can be adjusted to secure the best results. Except for the smallest stages, the height of each border from the floor should be adjustable within reasonable limits. Where the height will be such that the borders cannot be reached by means of a stepladder for adjustment, cleaning and replacing lamps, each border should be hung on two or more flexible steel cables passing over sheaves and down to a counterweight at the wall on one side of the stage. Except where a borderlight is permanently secured in position, the necessary number of circuits should be brought to the border in a borderlight cable from a junction box on the stage ceiling. (For a fully-equipped stage the junction boxes must be placed on the gridiron.)

### Stage Pockets

For the connection of portable lighting equipment, a stage floor pocket should be installed at each side of the stage on a line with each border and 6 ft. from the line of the proscenium opening, measuring away from the center line of the stage. Each pocket should be equipped with two receptacles, one to be wired from the control board on a separate circuit of No. 12 wire and the other on a separate circuit of No. 6 wire.

In some cases where the stage is small it may be satisfactory to provide, in place of floor pockets, one or more convenience outlets on each side wall of the stage. These outlets should be provided with duplex receptacles of the split-circuit type and each outlet should be wired on a separate three-wire circuit from the control board.

### Control

Stage lighting control equipment must be dead front and may be in the form of a panelboard or a switchboard. For small stages the switches on the control board usually control the lighting circuits directly. For a large and well-equipped stage the control switches are commonly of the remote-control type operated from a pilot board on the stage.

Where the stage is small and the lighting equipment is very simple, a standard lighting panelboard with a switch or circuit-breaker for each branch circuit may be satisfactory. If three colors are used, the minimum requirements would be three circuits for the footlight, three circuits for each borderlight and two circuits for each stage floor pocket.

Fairly complete control equipment for a stage of medium size is listed in Section 811.2.5 of the following specifications. In addition to the stage lighting control, all auditorium lights should be controlled at the stage control board.

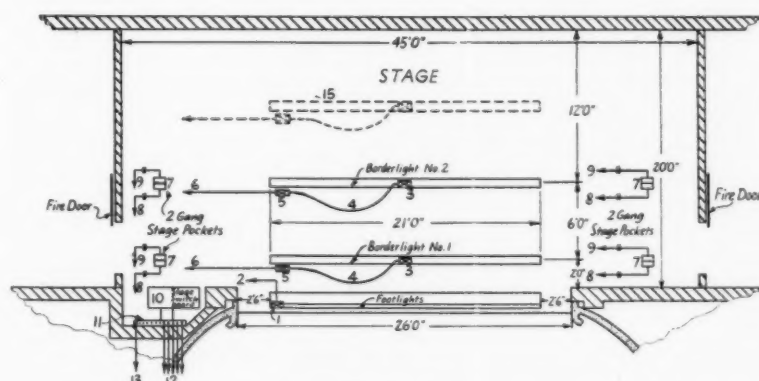
### Dimmers

A set of dimmers should be provided in every case where the stage will at times be used for theatrical entertainments. One dimmer unit, operated by a separate lever, is required for each separately controlled group of lights; for example, the control system indicated in Section 811.2.6. would require 12 dimmer units for the footlights and borderlights. The dimmers may also be provided with interlocking equipment and master levers so that all lights of any one color can be dimmed or brightened simultaneously, and various other combinations can be made.

## 811.2. Specifications

### 811.2.1. General

Furnish and install stage lighting equipment, stage floor



Stage Lighting Layout

1. Junction box below stage for footlight circuit connections.
2. Circuits from footlights to stage sw. bd.
3. Junction box at center of each borderlight for flexible supply cable connections.
4. Flexible cable connections to each borderlight.
5. Gridiron junction box for flexible borderlight cable.
6. Circuits from borderlights to stage sw. board.
7. Stage pockets.
8. Circuits from pockets to stage sw. board, No. 12 wire.
9. Circuits from pockets to stage switchboard, No. 6 wire.
10. Stage switchboard (with or without dimmers).
11. Terminal or fuse cabinet.
12. Circuits to auditorium lights.
13. Remote control circuit to booth.
14. Remote control master switches usually below stage (if used).
15. Additional border, for use when full depth of stage is utilized for scenery.

pockets and control board as hereinafter specified complete with all wiring and connections, all to be located as shown on the plans.

### 811.2.2. Footlights

- a-1. Provide a footlight — ft. long
- a-2. Provide a disappearing footlight made up of — 5-ft. sections equipped with lampholders and individual reflectors in (one row) (two rows) for a total of —, — watt lamps wired so that lamps are equally divided between three colors. Reflectors shall be equipped with glass roundels, one-third to be clear glass, one-third red and one-third blue. Footlights shall be (manufacturer's name and catalog number).

### 811.2.3. Borderlights

Provide — borderlights (manufacturer's name and catalog number) each to be — ft. long and to be equipped with lampholders and individual reflectors for —, — watt lamps wired so that lamps are equally divided between three colors. Reflectors shall be equipped with glass roundels, one-third to be clear glass, one-third red and one-third blue. Borderlights shall be hung on steel chains so that the angle of light throw can be adjusted and

- a-1. suspended from the stage ceiling so that their height can be adjusted through a range of three feet.
- a-2. suspended by means of flexible steel cables passing over sheaves and down to counterweights so arranged that the borders can be lowered to within 6 ft. from the stage floor. A ½-in. hand rope shall be provided for raising and lowering each counterweight. Connections shall be made to each borderlight through a standard borderlight cable containing the necessary number of No. 12 stranded conductors.

### 811.2.4. Stage Floor Pockets

Install flush in stage floor — stage floor pockets (manufacturer's name and catalog number), each to have one arc receptacle wired from the stage control board on a separate circuit of two No. 6 wires, and one incandescent receptacle wired on a separate circuit of two No. 12 wires. Furnish — arc plugs and — incandescent plugs to fit receptacles.

### 811.2.5. Control Board

All stage and auditorium lighting circuits, except circuits for emergency and exit lighting, shall be controlled at the stage control board.

- a-1. Provide a (manufacturer's name and catalog number) panelboard and cabinet with (plug fuses and switches) (circuit-breakers) for the control of — branch circuits.
- a-2. Provide a dead-front stage switchboard with steel plates at ends and top extending to proscenium wall to form a complete enclosure. A door shall be provided at one end for access to the space in the rear of the board. Provide the following control switches and all necessary fuses. All switches shall be of ample rating for the load to be controlled and the rating shall in no case be less than 30 amp.

*Note:* The following list is typical and should be modified as necessary to meet the actual conditions.

### 811.2.6. Control Switches

- 1—Stage Master controlling all stage lighting except pockets
- 1—White Master controlling all white lights
- 1—Red Master controlling all red lights
- 1—Blue Master controlling all blue lights

4—White	{	Foots
		Border No. 1
		Border No. 2
4—Red	{	Foots
		Border No. 1
		Border No. 2
4—Blue	{	Foots
		Border No. 1
		Border No. 2

### 12 for Stage Pockets

- 1 — House Master controlling all auditorium lighting (except emergency and exit lights).
- controlling auditorium lighting. (Specify here the switches needed to provide the desired divided control of the auditorium lighting.)

### 811.2.7. Dimmers

a-1. Install immediately above the stage control panelboard a bank of dimmers in a metal enclosure with operating levers projecting through the front. One or more sides of the enclosure may be of heavy steel mesh. The enclosure shall be so constructed as to give access to the dimmer plates for servicing or removal and shall be suitably ventilated. Dimmers shall be (manufacturer's name and type number). Provide the following dimmer units:

List here the circuits to be provided with dimmers. This arrangement will not be satisfactory if any group of lights to be individually dimmed, such as the white footlights, is controlled by two or more circuit switches.

a-2. Provide as a part of the stage switchboard a bank of dimmers mounted in the switchboard enclosure with operating levers projecting through the face of the board. Dimmers shall be (manufacturer's name and type number). Provide the following dimmer units:

List here the groups of lights to be provided with dimmers; the common requirement is one dimmer unit for each color in each borderlight and one for each color in the footlights. One or more pocket circuits may also be provided with dimmers. If interlocking equipment with master levers is required, a manufacturer of such equipment should be consulted before the specifications are written.

## 812. Private Telephone Systems

The following are the more commonly used types of private telephone systems:

- A. Two-station System.
- B. Common Ringing and Common Talking System.
- C. Selective Ringing and Common Talking System.
- D. Selective Ringing and Selective Talking System.
- E. Selective Ringing and Selective Talking System With Master Annunciator.
- F. Private Exchange Manual Switchboard System.
- G. Private Exchange Automatic System.
- H. Apartment House System, Selective Ringing and Common Talking, No Janitor's Station.
- I. Apartment House System, Selective Ringing and Common Talking, With Janitor's Station.
- J. Apartment House System, Selective Ringing and Common Talking, With Janitor's Station and Tradesmen's Station.

**812.1. Description****A. Two-station System**

This system is suitable for use where communication is required between two stations only.

**B. Common Ringing and Common Talking System**

This system is suitable where a low-cost system is desired and the telephones will be used only infrequently. A pre-arranged code must be used for calling because the bells at all stations ring whenever a call is made.

**C. Selective Ringing and Common Talking System**

Any station can call and talk to any other station but only one conversation can be carried on at one time. This is a satisfactory system for use in a residence or in other occupancies where the system will be used only occasionally and where privacy is not necessary. About 12 stations is the practical limit for this system.

**D. Selective Ringing and Selective Talking System**

Any station can call any other station and as many conversations can be carried on at one time as there are pairs of stations. This system is suitable where a reasonable degree of privacy is desired or where the system will be used frequently and must always be available for instant service. About 21 stations is the practical limit for this system.

**E. Selective Ringing and Selective Talking System With Master Annunciator**

System E provides for communication between one master station and any number of outlying stations up to 100. Any station can call the master station. Each incoming call is registered on an annunciator at the master station, the attendant then plugs into a jack connected with the calling station and answers the call. The attendant can call any outlying station by plugging into the corresponding station and pressing a calling button. This system is quite commonly used in apartment buildings where a doorman is on duty continuously at the main entrance.

**F. Private Exchange Switchboard System**

A switchboard system provides complete intercommunication service and can be arranged for as many simultaneous conversations as desired. Such a system should be selected where the number of stations exceeds the practical limits of System D and where it will be practicable to provide an operator at all times when the telephone system is in use.

**G. Private Exchange Automatic System**

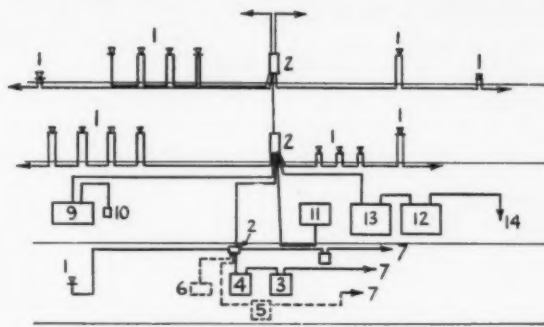
This system provides the same service as System F and is similar in all respects except that the manually operated switchboard of System F is replaced by automatic equipment so that no operator is required.

**H. Apartment House System, Selective Ringing and Common Talking, With No Janitor's Station**

This is a modification of System C which is suitable for use in an apartment building where no janitor is continuously on duty. A telephone is provided in the vestibule and in each apartment. A person in the vestibule can call and talk to any apartment. Each apartment telephone is provided with a pushbutton to operate the door opener and a pushbutton and bell or buzzer is provided at the front and rear door to each apartment.

**I. Apartment House System, Selective Ringing and Common Talking, With Janitor's Station**

System I is the same as System H except that it is intended for use where a janitor will be on duty continuously and includes a special station in the janitor's apartment. A person

**Private Intercommunicating Telephones**

- |   |   |
|---|---|
| 1—Private Telephone Outlets   | 9—(Ap't. House System) Vestibule Telephones                         |
| 2—Cross-Connecting Terminal Cabinets  | 10—(Ap't. House System) Door Opener                                 |
| 3—Battery Charger   | 11—Office Switchboard (Ap't. or Hotel)                              |
| 4—Storage Batteries   | 12—Automatic Switchboard in place of Nos. 9, 10 & 11                |
| 5—Power Rectifying Unit in place of 3 & 4   | 13—Cross-Connecting Frame for No. 12 (on large systems)             |
| 6—Dry Cell Batteries in place of 3, 4 & 5   | 14—Circuit from Motor-Generator, when Recommended for large systems |
| 7—Power Supply to No. 3, No. 5 or No. 8   |   |
| 8—(Shown below No. 11, but not numbered) Transformer for Ringing & Door Opener Circuits |   |

in the vestibule can call and talk to any apartment or the janitor. Any apartment can call and talk to the janitor and operate the door opener. The janitor can call and talk to any apartment and operate door opener. A pushbutton and bell or buzzer is provided at the front and rear door to each apartment.

**J. Apartment House System, Selective Ringing and Common Talking, With Janitor's Station and Tradesmen's Station**

This system is similar to System I but includes a special station in the tradesmen's entrance. Calling and talking is the same as with System I and in addition a person in the tradesmen's entrance can call and talk to any apartment or the janitor. A pushbutton and buzzer is provided at the rear door to each apartment.

**812.2. Specifications****812.2.1. System**

Furnish and install a (give here the descriptive designation of the system, such as "selective ringing common talking" and the manufacturer's name and catalog number) telephone system with — stations located as shown on the plans. All telephones and other equipment, except raceways, outlet and junction boxes and single and twisted pair conductors shall be the product of (name of manufacturer) and the entire system shall be installed in conformity with the manufacturer's specifications.

**812.2.2. Telephones**

- a-1. All telephones shall be
- a-2. As indicated on the plans, telephones shall be
  - b-1. surface wall type, Cat. No. —
  - b-2. flush wall type, Cat. No. —
  - b-3. desk type, Cat. No. —, with separate ringer box
  - b-4. except that the vestibule telephone shall be Cat. No. — the janitor's telephone shall be No. — and the telephone in the tradesmen's entrance shall be No. —.

**812.2.3. Conductors**

All single and twisted pair conductors shall be rubber insulated and covered with a cotton braid saturated with a



moisture-resistant compound. All cables shall be lead covered.

#### 812.2.4. Wiring Method

All conductors, including cables, shall be installed in (raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each station outlet in an outlet box suitable for the type of telephone to be installed.

812.2.5. Specify such of the following items as are required for the system to be installed:

	System									
	A. Two-Station	B. Common Ringing, Common Talking	C. Selective Ringing, Common Talking	D. Selective Ringing, Selective Talking	E. Master Annunciator	F. Switchboard System	G. Automatic System	H. Apartment House System	I. Apartment House System	J. Apartment House System
Dry-cell talking and ringing battery.....	X									
Dry-cell talking battery and transformer for ringing, or										
Storage battery and charger for talking and transformer for ringing, or		X	X	X	X	X	X	X	X	X
Rectifier unit										
Switchboard.....						X				
Automatic Selectors.....							X			
Master Annunciator.....					X					
Cross connecting cabinet.					X	X	X			
Terminal cabinets.....			X	X	X	X				
Letter boxes.....								X	X	X
Door opener.....								X	X	X
Pushbuttons (for front and rear door).....					X			X	X	X
Bell and buzzer (for front and rear door)					X			X	X	X

### 813. Public Telephone Systems

- A. Single Station.
- B. Main Station With One or More Extensions.
- C. Private Branch Exchange.
- D. Automatic Private Branch Exchange.
- E. Distribution System for a Multiple-Occupancy Building.

#### 813.1. Description

System A, B, C and D are treated here as entirely separate systems, each providing the entire telephone service for an individual subscriber. In a building occupied by a number of tenants, such, for example, as a large office building, the service provided for any one tenant may consist of any one of the above systems A to D inclusive, and in such a case a distribution system extending throughout the entire building must be provided.

In any case except where the requirements can be met by System A or System B with one or two extensions, the engineers of the telephone company should be consulted and their advice should be followed in laying out the raceway system.

##### A. Single Station

In a commercial occupancy a single telephone will obviously be adequate only where the use of the telephone is

infrequent or is confined chiefly to one person. System B is preferable in the majority of single-family dwellings.

##### B. Main Station With One or More Extensions

This system is suitable for use where a single incoming line is sufficient but it is convenient to be able to answer incoming calls or make outgoing calls from two or more locations. The system cannot be used for communicating between the two or more local stations without additional auxiliary equipment. It is not commonly used where the total number of stations exceeds three.

##### C. Private Branch Exchange

This system or System D should be selected where complete facilities for intercommunication and for making calls through the public telephone exchange are necessary. One or more operators must be on duty at all times when the system is in use.

##### D. Automatic Private Branch Exchange

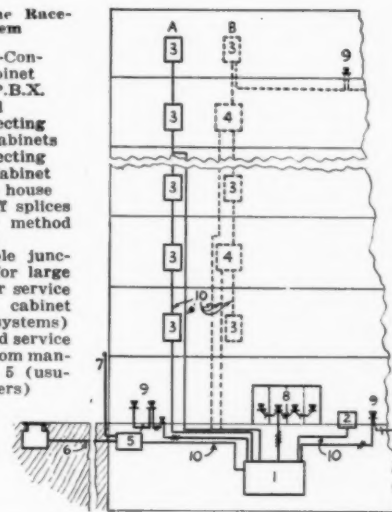
This system provides the same service as System C but automatic equipment is employed. One or more operators are required to handle incoming calls but calls between the local stations and outside calls are made through the automatic equipment, hence for a large system the number of operators required is much less than for System C. The raceway system is the same as that required for System C.

##### E. Distribution System for a Multiple-Occupancy Building

Raceways for a telephone distribution system should be provided in every multiple-occupancy building where two or more tenants are to be served from a common service entrance. The distribution system raceways carry trunk lines from the service entrance to centrally-located points on the

Public Telephone Raceway System

- 1—Main Cross-Connecting Cabinet
- 2—Central or P.B.X. Switchboard
- 3—Cross-Connecting Terminal Cabinets
- 4—Cross-Connecting Terminal Cabinet enlarged to house cable tap-off splices when riser method "B" is used
- 5—Service cable junction box (for large systems), or service protector cabinet (for small systems)
- 6—Underground service raceways from man-hole to No. 5 (usually by others)
- 7—Overhead service raceway (instead of No. 6) for small systems in outlying areas
- 8—Outlets in telephone booths
- 9—Local telephone outlets, supplied through branch circuit raceways connected to No. 1, No. 3 or No. 4 cabinets
- 10—Raceways for main and riser cables



NOTE: Consult engineers of telephone company for recommended sizes and arrangement of service, cabinets and cable routings to suit the occupancy under consideration. Indicate by riser diagram and on other plans all raceway and cabinet sizes, and the number of pairs in all branch circuit raceways. Specify which items of material will be furnished and/or installed by others.



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**B-3. Magneto Type, Detector and Annunciator**

This system is similar to System B-2 except that a visual indicator is provided as a part of the central recording clock. The watchman upon completing his tour may check the indicators to determine whether all stations were visited and recorded.

**C. Leased-Wire Supervisory System**

This system is usually furnished under lease to provide a record at a central headquarters of watchman tours. A central control panel is usually furnished under the lease which is connected electrically over leased wires to a remote supervisory office. Wiring connections are provided to several watchman stations from the central panel. On large systems a combination of keys is used which requires only each tenth station along the watchman's route to be electrically connected. Except for large systems, the current supply is provided over the outgoing leased wires.

Wiring details should be obtained to determine which portions of the system are provided with the supervisory service, and which portions are to be provided by the owner.

**814.2. Specifications**

814.2.1. Furnish and install a (give here descriptive designation of the system, manufacturer's name and catalog number) watchman's system as indicated on the wiring plans.

**814.2.2. Conductors**

All conductors shall be No. — ga., and shall have 600-volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade specified elsewhere.

**814.2.3. Wiring Method**

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed.) Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

**814.2.4. Equipment**

For Systems A—(1) Time detector with clock, (2) Time detector without clock, (3) Watchman stations (flush) (surface), (4) Battery, (5) Battery charger.

For System B—(1) Time detector with clock, (2) Time detector without clock, (3) Clock and visual indicator, (4) Magneto stations, (flush) (surface), (5) Portable magneto stations, (6) Plugging outlets for portable magneto stations.

For System C—a-1, Furnish and install all equipment and wiring as shown on plans, except:

a-2, Furnish and install a system of empty raceways, junction boxes and outlet boxes as shown on plans. The wiring and equipment will be furnished and installed by others.

## Part 9

# Master Specifications for Wiring Installations

## In Single-Family Dwellings

Optional provisions are indicated a, b, c, etc. Alternate provisions are indicated as a-1, a-2, b-1, b-2, etc.

**901. Proposals****902. Terms of Payment****903. Codes, Permits and Inspections**

The installation shall comply with all laws applying to electrical installations in effect in the ....., with the regulations of the National Electrical Code where such regulations do not conflict with the laws in effect, and with the regulations of the public utility company furnishing the electric service.

a-1. (In localities where electrical installations are governed by municipal ordinances.) The contractor shall obtain all permits required by the ordinances of the City of ..... and after completion of the work shall furnish to the owner or architect a certificate of final inspection and approval from the electrical inspection department of the City of .....

a-2. (In localities where no ordinance governing electrical work is in effect.) After completion of the work the contractor shall furnish to the owner or architect a certificate of final inspection and approval from the Underwriters' Inspection Bureau having jurisdiction.

**904. Standards for Materials and Workmanship**

All materials shall be new and shall conform with the standards of Underwriters' Laboratories, Inc., in every case where such a standard has been established for the particular type of material in question.

All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance when completed.

**905. Drawings**

These specifications are accompanied by floor plans of the building showing the location of all outlets and the switch control,

a. and the layout of the branch circuits.

The drawings and these specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

**906. Changes and Additional Work****907. Liability Insurance****908. Progress of Work**

**909. Guarantee**

The contractor shall leave the entire electrical system installed under this contract in proper working order and shall, without additional charge, replace any work or material which develops defects, except from ordinary wear and tear, within one year from the date of the final certificate of approval issued by the inspection department as called for in Section 903.

**910. Scope of These Specifications**

The work to be done under these specifications shall include the furnishing of all labor and material required to complete the installation of the following items, in accordance with these specifications and the accompanying drawings.

All outlets, the location of wall switches, and the outlet or outlets controlled by each switch should be shown clearly on the floor plans.

List here items to be included in the contract for the electric wiring.

**911. Types of Wiring**

The types of wiring used for the various portions of the light and power wiring shall be as follows:

For the service conductors: .....

For the circuit from the panelboard to the range outlets: .....

a. For .....

b. For .....

For all other light and power wiring: .....

Section 911 may be omitted if the National Electrical Code or local ordinance rules governing the use of the various types of wiring are considered adequate for the installation in question.

Types of wiring must be selected that are on conformity with any local rules than may be in effect. The following are the types recognized in the National Electrical Code that are most commonly used in house wiring; some of these types are not suitable for concealed work in fireproof construction.

For service entrance conductors where an overhead service is run to a building—rigid metal conduit, electrical metallic tubing, service entrance cable.

For underground service entrance conductors, also for any other conductors run underground:—Lead-covered cable in rigid metal conduit or electrical metallic tubing, lead-covered cable in tile or fibre duct, lead-covered and steel-armored cable (known as "parkway cable") and cable with heavy braiding specially treated to withstand the action of chemical reagents in the soil.

For all wiring inside the building, assuming wood frame interior construction:—Knob-and-tube work, non-metallic sheathed cable, armored cable, rigid metal conduit, flexible metal conduit, electrical metallic tubing and surface metal raceway of the multi-outlet type.

**912. Service Conductors and Feeders**

The service will be

a-1. Three-wire, 115-230 volts, single-phase.

a-2. Three-wire, 120-208 volts, open Y from three-phase, four-wire secondary mains.

b-1. The service raceway.

b-2. The service cable shall terminate on the outside of the house at a point.

c-1. (Two-story house) approximately 18 ft. above the ground level.

c-2. (One-story house) as high as practicable above the ground level.

The service conductors shall not be smaller than No. .... except that a smaller neutral conductor may be used where permitted by the National Electrical Code and local ordinance.

The feeder conductors from the service switch to the branch circuit cabinet or cutout box shall be the same size as the service conductors, except that in all cases the neutral shall be of the same size as the outer conductors.

The local power company should be consulted as to the type

of service. Alternate a-1 describes the type used in the majority of localities.

The size of the service conductors should be determined according to Section 506 of the standards.

The service capacities specified in Section 506 provide in each case for a range and water heater and include reasonable allowances for additional power or heating loads. If any unusual power or heating loads are to be supplied, the local electrical inspection department or power company should be consulted.

**913. Service Equipment**

The service equipment shall consist of a

a-1. switch of — ampere rating and suitable fuses.

a-2. circuit-breaker of — ampere rating.

The type of equipment, method of mounting and provision for metering shall be in accordance with the service requirements of the ..... Light and Power Company.

The service equipment may be a switch and fuses or a circuit breaker. In either case the rating should be as specified in Section 506.

**914. Branch Circuit Equipment**

a-1. Furnish and install complete with cabinet, a panelboard having mains arranged for three-wire service, and branches equipped with fuse terminals for two 35-60 amp. fuses and receptacles for — plug fuses. The panelboard shall be of the dead-front type with no live parts exposed when the cabinet door is opened and all fuses are in place. A typewritten directory of circuits shall be mounted on the inside of the cabinet door showing the circuit controlled and the rating of the fuse or fuses to be used for each circuit. Furnish one complete set of fuses and 6 extra plug fuses. In place of a single panelboard, two or more panelboards and cabinets may be installed to provide the branch circuit equipment called for in this section.

a-2. Furnish and install, complete with cabinet, a panelboard having mains arranged for three-wire service and equipped with circuit-breakers for the protection of all branch circuits as follows: one 50 amp. DP or two 50 amp. SP for range circuit, one — amp. DP or two — amp. SP for water-heater circuit, — 20-amp. SP for the appliance circuits and — 15-amp. SP for the 15-amp. circuits. In place of a single panelboard, two or more panelboards and cabinets may be installed to provide the branch circuit equipment called for in this section.

The branch circuit protective equipment may consist of fuses only, switches and fuses, or circuit breakers. Switches are desirable but are not required by the National Electrical Code. A circuit-breaker takes the place of both a switch and fuse, providing a means of controlling the circuit as well as circuit protection.

One plug fuse, or a single-pole circuit-breaker, is required for each 15-amp. branch circuit and for each "appliance" branch circuit. Two plug fuses, or a double-pole circuit-breaker, or two single-pole circuit-breakers are required for a water heater circuit and two fuses, or a double-pole circuit-breaker, or two single-pole circuit-breakers for a range circuit. Suitable equipment should be provided for circuits to other appliances requiring individual branch circuits such as an oil burner, automatic stoker or built-in air heaters. In addition, it is desirable to supply at least two spare plug-fuse receptacles for future use or, if circuit-breakers are used, space for two additional breakers.

The circuit-breakers used for the protection of branch circuits must have a rating in amperes suitable for the protection of the conductors of that particular circuit.

**915. 15-Ampere Branch Circuits**

At least — 15-amp. branch circuits shall be installed. These circuits shall supply all lighting outlets and all convenience outlets except those which are supplied by appliance branch circuits as specified in the next section. The total number of such outlets shall be nearly as possible be equally divided between these circuits. In each living room, parlor, library, sun room, bedroom and each other principal room, the



outlets shall be divided between two or more branch circuits.

The number of 15-amp. circuits to be provided should be specified. Unless more circuits are required by the local ordinance, the required number should be computed according to Section 503 of the standards.

#### 916. Appliance Branch Circuits

At least one appliance branch circuit shall be installed to supply all convenience outlets in the dining room, breakfast room, kitchen and pantry,

a. and at least one such circuit shall be installed to supply all convenience outlets in the laundry.

These circuits shall not supply any other outlets, except that an electric refrigerator motor not larger than  $\frac{1}{4}$  hp. may be supplied by either one of these circuits, regardless of the location of the motor. No wire smaller than No. 12 shall be used for any appliance circuit.

#### 917. Individual Appliance Circuits

Install a circuit of three wires not smaller than No. 6 to the range outlet shown on the plans.

a-1. Provide at the range outlet a  $4\frac{1}{2}$  in. by  $4\frac{1}{2}$  in. by  $2\frac{7}{8}$  in. outlet box set flush in the wall with flat cover.

a-2. Provide at the range outlet a 50-amp., 3-pole flush receptacle.

a-3. Provide at the range outlet a 50-amp., 3-pole surface type receptacle.

Install a circuit of two wires not smaller than No. 12 to a suitable point near the location of the water heater and at this point install a 30-amp., 250-volt, 2-pole enclosed switch for disconnecting the water heater from the circuit.

Install a circuit of two wires not smaller than No. 12 to each bathroom heater shown on the plans. The wiring shall terminate in the steel box to enclose the heater.

b-1. Install a circuit of two wires not smaller than No. 12 to the point indicated on the plans for connection to the oil burner. The circuit shall be provided with a 30-amp., 250-volt, 2-pole enclosed switch for disconnecting the oil burner motor and its control equipment from the circuit, and the circuit shall terminate in a junction box at the oil burner location.

b-2. Install a circuit of two wires not smaller than No. 12 to the point indicated on the plans. The circuit shall be provided with a 30-amp., 250-volt, 2-pole enclosed switch for disconnecting the stoker motor and its control equipment from the circuit, and the circuit shall terminate in a junction box at the stoker location.

Specify No. 10 wire for the water-heater circuit if it is intended that a water heater shall be installed having rating exceeding 4,000 watts and not exceeding 5,000 watts.

Where special rates for water heating are in effect, the local power company's service rules may require the omission of the disconnecting switch at the water heater.

Where the oil burner is located in a special room partitioned off from the rest of the basement, it is desirable to have the switch controlling the circuit installed at some convenient point outside the room.

#### 918. Outlets and Wall Switches

Lighting outlets, convenience outlets and wall switches shall be installed as shown on the plans and the wiring shall be installed to provide the switch control indicated on the plans. All outlets and switches shall be accurately located. The plans indicate the location where there will be beamed ceilings, paneling and other interior finish requiring specially accurate location of outlets. The final locations of such outlets must be verified by the architect or other authorized representative of the owner. Except as otherwise specified, bracket outlets in bathrooms shall be 5 ft. above the floor, and all other bracket outlets shall be 5 ft. 6 in. above the

floor; wall switches shall be 4 ft. above the floor; and convenience outlets shall be

a-1. in the baseboard,

a-2. at a height of — inches above the floor, except that convenience outlets in the kitchen, pantry, breakfast nook and bathroom shall be placed at suitable heights, in general about 3 ft. above the floor; the clock outlet in the kitchen shall be 7 ft. above the floor; outlets for wall fans shall be 7 ft. above the floor; and the outlet for washer at the laundry tubs shall be on the ceiling.

#### 919. Multi-outlet Assembly

In the living room, — and — furnish and install a multi-outlet assembly as a member of the baseboard. The assembly shall be continuous with the baseboard and shall consist of a metal raceway with outlets to receive standard attachment plugs, spaced not over — inches apart.

#### 920. Materials

For a more complete detail of material specifications see Section 705 of the Master Specifications for Commercial and Industrial occupancies.

All lighting outlet boxes except those intended for drop cords or lamp receptacles shall be provided with suitable means for supporting the fixtures. Ceiling outlet boxes in all finished spaces shall be provided with covers having openings not larger than  $2\frac{7}{8}$  in. in diameter. Bracket outlet boxes in all finished spaces except the kitchen, bathrooms, and lavatory shall be provided with covers having openings not over  $1\frac{1}{2}$  in. wide.

Wall switches shall be of the tumbler type.

All convenience outlet receptacles shall be of the duplex or triplex type except at the clock outlet in the kitchen, at outlets for wall fans, and at weatherproof outlets located outdoors. The receptacle at the clock outlet shall be of the recessed type so that the plug when inserted will not project beyond the plate. The receptacle at the clock outlet shall be provided with suitable means for supporting the clock, and means for supporting fans shall be provided at fan outlets. Except where located under porch roofs, receptacles installed outdoors shall be of the weatherproof type.

a-1. Switch and receptacle plates shall be of brass, 0.060 in. thick, finished to match the hardware in the rooms where they are placed.

a-2. Switch and receptacle plates shall be of bakelite or other special material and of design and finish approved by the ————.

The outlet for the washer shall be so located as to be convenient to the laundry tubs. If located above the washer location, it shall consist of a pendant of type S or SJ cord terminating in a suitable cord connector at a convenient height.

Nearly all manufacturers of wall switches and plug receptacles make two or more grades of these devices and it is usually preferable to specify one of the better grades by mentioning two or more makes and catalog numbers and calling for these devices or others approved by the architect as of equal grade.

#### 921. Master Switch Control

All outlets marked MS on the plans shall be so wired that one light at each outlet can be controlled by a master switch with bull's-eye pilot light, located in the owner's bedroom. The connections shall be such that when the master switch is in the open position the lights can be turned on or off by means of the local switches in the usual manner.

#### 922. Lighting Fixtures

Note: A schedule of lighting fixtures should be prepared stating who is to supply.

#### 923. Electric Cooking Equipment

#### 924. Electric Heating Equipment



**925. Motor-driven Appliances**

If any of the above items are to be furnished by the wiring contractor, suitable specifications should be drawn up by the architect or builder and included under the proper headings.

**926. Electric Kitchen**

Specify here such of the following equipment as the contractor is to furnish or install or both, giving with each the manufacturer's name and catalog number:

Electric range, electric refrigerator, electric dishwasher, electric clock, ventilating fan.

Note: Consult local power company or electrical league for detailed information on electrical kitchen layout and size of electrical devices to be specified.

**927. Signalling Systems**

At front and other outside doors, install push buttons with plates of design and finish as approved by the architect. In the center of the dining room floor install a signalling type receptacle with plug. The plug shall be of a type which cannot be inserted in receptacles used as convenience outlets. Furnish a floor tread connected to the plug by a 6-ft. cord. All wiring shall be done with braided rubber-insulated wire, not smaller than No. 18, with all joints soldered and taped with friction tape.

a-1. Install in the kitchen one loud buzzer for rear door, one vibrating bell for front door and one mild tone single-stroke bell for dining room call, also install and connect up a bell-ringing transformer at a suitable location.

a-2. At location shown on the plans in the front entrance hall install a two-tone chime wired to front door push button for single-stroke operation and wire to a push button in kitchen for chime operation for dinner service call. Install in kitchen one loud buzzer for rear door and one mild tone single-stroke bell for dining room call, also install and connect up a bell-ringing transformer at a suitable location.

The above are typical specifications that are suitable for most small residences. In a residence planned for the employment of one or more servants, one of the preceding paragraphs may be used with the following addition:

b. At each interior push button location indicated on the plans install

b-1. a flush wall type push button ganged with the switch controlling the lights.

b-2. a flush bell pull switch at the ceiling line, except that a flush wall type push button shall be installed in the bathroom.

c. Install at location shown on plan a flush annunciator with an indication for each calling station specified above, the drops to be properly lettered to correspond to the calling stations. The finish of the annunciator and push button plates shall be as directed by the architect.

**928. Telephone Raceways**

From a point on the outside wall which can be conveniently reached by the telephone company's service and at a height of not less than 10 ft. above the ground level, run a ½-in. rigid metal conduit or electrical metallic tubing concealed to the basement. At the outer end, this raceway shall terminate in a suitable weatherproof service head and the raceway shall terminate in the basement in a 8-in. by 10-in. by 4-in. steel box.

From this box install conduit or tubing of size satisfactory to the local telephone company to all public telephone outlets.

a-1. The outlets shall consist of standard switch outlet boxes provided with telephone plates of material and finish the same as specified for switch and receptacle plates and having bushed holes for cords.

a-2. Each outlet shall consist of a flush metal box to contain the telephone ringer with cover of design and finish approved by the architect. The dimensions of the box shall be such as will meet the specifications of the local telephone company.

Where more than two or three telephones are to be installed, it is advisable to consult the local telephone company in regard to the specifications for this equipment.

**929. Intercommunicating Telephone System**

At each location indicated on the plans install a flush wall type telephone of the common talking type. The flush plates shall have special finish as directed by the architect. Furnish and install the necessary dry-cell battery for talking, and transformer for ringing circuit. The wiring for this system shall be done with braided rubber-insulated wire not smaller than No. 18 and all joints shall be soldered and taped.

If a system including more than three or four telephones is contemplated, a manufacturer of this type of equipment should be consulted. (See Section 13).

**930. Radio Wiring**

At each radio outlet shown on the plans install a suitable flush outlet box, a special radio receptacle, and a plug receptacle for power supply to the receiving set.

From each outlet run a No. 14 rubber-covered wire to the attic, leaving the end accessible. This wire shall be kept as far away as practicable from all piping or other electric wiring and shall not be run parallel to any pipe or wire unless kept at a distance of at least 3 ft. therefrom. From each outlet run a No. 14 rubber-covered wire to the basement and connect this wire to a cold water pipe by means of a copper ground clamp.

Note: To insure best results in short-wave reception, in place of the above a complete antenna system, System A, Section 801, should be specified.

## Engineering Data

### A.S.A. STANDARD SYMBOLS FOR ELECTRICAL EQUIPMENT OF BUILDINGS

Ceiling Outlet.....		Remote Control Push Button Switch.....	$S^R$	Maid's Plug.....	
Ceiling Outlet (Gas and Electric)		Tank Switch.....		Horn Outlet.....	
Ceiling Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain.....		Motor.....		District Messenger Call.....	
Ceiling Outlet for Extensions...		Motor Controller.....		Clock (Secondary):.....	
Ceiling Fan Outlet.....		Lighting Panel.....		Clock (Master).....	
Floor Outlet.....		Power Panel.....		Time Stamp.....	
Drop Cord.....		Heating Panel.....		Electric Door Opener.....	
Wall Bracket.....		Pull Box.....		Watchman Station.....	
Wall Bracket (Gas and Electric)		Cable Supporting Box.....		Watchman Central Station Detector.....	
Wall Outlet for Extensions.....		Meter.....		Public Telephone—P. B. X. Switchboard.....	
Wall Fan Outlet.....		Transformer.....		Interior Telephone Central Switchboard.....	
Wall Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain.....		Branch Circuit, Run Concealed under Floor Above.....	—	Interconnection Cabinet.....	
Single Convenience Outlet.....		Branch Circuit, Run Exposed...	----	Telephone Cabinet.....	
Double Convenience Outlet...		Branch Circuit, Run Concealed Under Floor.....	----	Telegraph Cabinet.....	
Junction Box.....		Feeder Run, Concealed under Floor Above.....	—	Special Outlet for Signal System as Described in Specification.....	
Special Purpose Outlet—Lighting, Heating and Power as Described in Specification....		Feeder Run, Exposed.....	----	Battery.....	
Special Purpose Outlet—Lighting, Heating and Power as Described in Specification....		Feeder Run, Concealed under Floor.....	----	Signal Wires in Conduit Concealed Under Floor.....	----
Special Purpose Outlet—Lighting, Heating and Power as Described in Specification....		Pole Line.....		Signal Wires in Conduit Concealed under Floor Above.....	----
Exit Light.....		Push Button.....		This Character Marked on Tap Circuits Indicates 2 No. 14 Conductors in 1/2-in. Conduit (see note).....	
Floor Elbow.....		Buzzer.....		3 No. 14 Conductors in 1/2-in. Conduit.....	
Floor Tee.....		Bell.....		4 No. 14 Conductors in 3/4-in. Conduit Unless Marked 1/2-in. ....	
Pull Switch.....		Annunciator.....		5 No. 14 Conductors in 3/4-in. Conduit.....	
Local Switch—Single Pole.....	$S^1$	Interior Telephone.....		6 No. 14 Conductors in 1-in. Conduit Unless Marked 3/4-in. ....	
Local Switch—Double Pole.....	$S^2$	Public Telephone.....		7 No. 14 Conductors in 1-in. Conduit.....	
Local Switch—3 Way.....	$S^3$	Local Fire Alarm Gong.....		8 No. 14 Conductors in 1-in. Conduit.....	
Local Switch—4 Way.....	$S^4$	City Fire Alarm Station.....			
Automatic Door Switch.....	$S^D$	Local Fire Alarm Station.....			
Key Push Button Switch.....	$S^K$	Fire Alarm Central Station.....			
Electroliner Switch.....	$S^E$	Speaking Tube.....			
Push Button Switch and Pilot...	$S^P$	Nurse's Signal Plug.....			

NOTE.—If larger conductors than Number 14 are used, use the same symbols and mark the conductor and conduit size on the run.

## TWO-WIRE AND THREE-WIRE SYSTEMS

Size of Conductor	Number of Conductors in One Conduit								
	1	2	3	4	5	6	7	8	9
	Minimum Size of Conduit in Inches								
No. 14	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
12	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
10	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
6	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
5	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
4	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
3	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
2	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
0	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
00	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
200,000 C.M.	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
225,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
250,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
300,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
350,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
400,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
450,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
500,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
550,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
600,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
650,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
700,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
750,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
800,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
850,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
900,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
950,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,000,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,100,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,200,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,250,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,300,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,400,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,500,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,600,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,700,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,750,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,800,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,900,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
2,000,000	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8

## DIMENSIONS OF RUBBER-COVERED CONDUCTORS

Size AWG	Approx. Area Over Braid Sq. Inches
14	.031
12	.038
10	.045
8	.071
6	.13
4	.16
2	.21
1	.27
1/0	.31
2/0	.35
3/0	.41
4/0	.48
250,000 C.M.	.58
300,000	.67
350,000	.75
400,000	.83
450,000	.91
500,000	.99
550,000	1.08
600,000	1.16
650,000	1.23
700,000	1.30
750,000	1.38
800,000	1.45
850,000	1.52
900,000	1.60
950,000	1.68
1,000,000	1.75
1,250,000	2.22
1,500,000	2.52
1,750,000	2.85
2,000,000	3.14

No. 14 to 8, solid conductor;  
No. 6 and larger, stranded.

## DIMENSIONS OF LEAD-COVERED CONDUCTORS

Size AWG	Approx. Diam. Over Lead Inches	Approx. Area Over Lead Sq. Inches
14	.25	.0491
12	.26	.0531
10	.32	.0804
8	.38	.1130
6	.46	.168
4	.51	.204
2	.57	.255
1	.64	.322
1/0	.68	.363
2/0	.72	.407
3/0	.78	.478
4/0	.83	.541
250,000	.99	.779
300,000	1.04	.849
400,000	1.14	1.02
450,000	1.18	1.09
500,000	1.22	1.17
550,000	1.34	1.41
600,000	1.37	1.47
650,000	1.41	1.56
700,000	1.44	1.63
750,000	1.48	1.72
800,000	1.51	1.79
850,000	1.53	1.84
900,000	1.57	1.94
950,000	1.59	1.99
1,000,000	1.63	2.09
1,250,000	1.81	2.57
1,500,000	1.94	2.95
1,750,000	2.05	3.30
2,000,000	2.16	3.66

No. 14 to 8, solid conductor; No. 6 and larger, stranded.

## CONDUIT SIZES FOR 600-VOLT WIRES WITH ASBESTOS AND VARNISHED CAMBRIC INSULATION

Size Wire	O. D. in Inches	NUMBER OF WIRES								
		1	2	3	4	5	6	7	8	9
		MINIMUM SIZE OF CONDUIT								
14	.273	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
12	.292	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
10	.316	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
8	.345	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
6	.385	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
5	.409	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
4	.434	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
3	.460	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
2	.495	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1	.562	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
0	.604	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
00	.650	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
000	.700	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
0000	.761	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
250,000	.815	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
300,000	.920	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
350,000	.971	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
400,000	1.019	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
450,000	1.063	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
500,000	1.105	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
600,000	1.182	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
700,000	1.254	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
750,000	1.288	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
800,000	1.321	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
900,000	1.383	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
1,000,000	1.442	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8

## STAGE POCKET AND BORDER CIRCUITS, AND ELSEWHERE BY SPECIAL PERMISSION

Size of Conductor	Maximum Number of Conductors in Conduit					
	Inch 1	Inch 1 1/4	Inch 1 1/2	Inch 2	Inch 2 1/2	Inch 3
14	11	19	26	43	61	95
12		15	21	34	50	77
10		12	16	27	38	60
8			13	22	31	49
6					14	22

## COMBINATION OF CONDUCTORS

For groups or combinations of conductors it is recommended that the conduit be of such size that the sum of the cross-sectional areas of the individual conductors will not be more than the percentage of the interior cross-sectional area of the conduit than as shown in the following table:

## PERCENT AREA OF CONDUIT

	Number of Conductors				
	1	2	3	4	Over 4
Conductors (not lead covered).....	53	31	43	40	40
Lead-covered conductors.....	55	30	40	38	35

## DIMENSIONS OF CONDUIT

Size	Internal Diameter Inches	Area Square Inches	Size	Internal Diameter Inches	Area Square Inches
1/8	.622	.30	3	3.068	7.38
1/4	.824	.53	3 1/2	3.548	9.90
1/2	1.049	.86	4	4.026	12.72
3/4	1.300	1.50	4 1/2	4.506	15.95
1	1.610	2.04	5	5.047	20.00
2	2.067	3.36	6	6.065	28.89
2 1/2	2.469	4.79			

# ENGINEERING DATA

## RIGID METAL CONDUIT—WEIGHTS AND DIMENSION

Trade size, inches	Length	Conduit						Elbows			
		Nominal weight, pounds per foot	External diameter, inches	Nominal internal diameter, inches	Nominal wall thickness, inches	Minimum weight 10 lengths, pounds	Threads per inch	Nominal weight, pounds per 100	Dimensions, inches		
									A	B	C
1/2	9' 11 1/2"	0.852	0.840	0.622	0.109	79	14	83	4	2 1/4	6 1/4
3/4	9' 11 1/2"	1.134	1.050	0.824	0.113	105	14	123	4 1/4	2 3/4	7 1/4
1	9' 11 1/2"	1.684	1.315	1.049	0.133	153	11 1/2	203	5 1/4	2 3/4	8 3/4
1 1/4	9' 11"	2.281	1.660	1.380	0.140	201	11 1/2	318	7 1/4	2 3/4	10
1 1/2	9' 11"	2.731	1.990	1.610	0.145	249	11 1/2	432	8 1/4	2 3/4	11
2	9' 11"	3.678	2.375	2.067	0.154	334	11 1/2	705	9 1/2	4 3/8	13 1/4
2 1/2	9' 10 1/2"	5.819	2.875	2.460	0.203	527	8	1,261	10 1/2	5 1/2	15 1/4
3	9' 10 1/2"	7.616	3.500	3.068	0.216	690	8	1,640	13	4 1/4	17 1/4
3 1/2	9' 10"	9.282	4.000	3.548	0.226	831	8	2,530	15	5	20
4	9' 10"	10.889	4.500	4.026	0.237	982	8	3,176	16	5 1/2	21 1/4
4 1/2	9' 10"	12.642	5.000	4.506	0.247	1,150	8	4,110	18	5 1/2	23 1/2
5	9' 8"	14.810	5.563	5.047	0.258	1,344	8	6,170	24	5	29
6	9' 9"	19.185	6.625	6.065	0.280	1,770	8	9,590	30	6 1/4	36 1/4

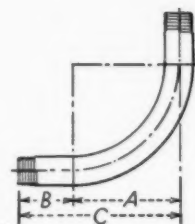


TABLE OF ALLOWABLE CARRYING CAPACITIES OF CONDUCTORS

Gage No.	Diameter of Solid Wires in Mils	Area in Circular Mils	Column A Rubber Insulation, Amperes	Column B Varnished Cambric Insulation, Amperes	Column C Other Insulation, and Bare Conductors, Amperes
18	40.3	1,624	3	6	6"
16	50.8	2,583	6	10	10"
14	64.1	4,107	15	18	20
12	80.8	6,530	20	25	30
10	101.9	10,380	25	30	35
8	128.5	16,510	35	40	50
6	162.0	26,250	50	60	70
5	181.9	33,100	55	65	80
4	204.3	41,740	70	85	90
3	229.4	52,630	80	95	100
2	257.6	66,370	90	110	125
1	289.3	83,690	100	120	150
0	325.0	105,500	125	150	200
00	364.8	133,100	150	180	225
000	409.6	167,800	175	210	275
		200,000	200	240	300
0000	460.0	211,600	225	270	325
		250,000	250	300	350
		300,000	275	330	400
		350,000	300	360	450
		400,000	325	390	500
		500,000	400	480	600
		600,000	450	540	680
		700,000	500	600	760
		750,000	525	630	800
		800,000	550	660	840
		900,000	600	720	920
		1,000,000	650	780	1,000
		1,100,000	690	830	1,080
		1,200,000	730	880	1,150
		1,300,000	770	920	1,220
		1,400,000	810	970	1,290
		1,500,000	850	1,020	1,360
		1,600,000	890	1,070	1,430
		1,700,000	930	1,120	1,490
		1,800,000	970	1,160	1,550
		1,900,000	1,010	1,210	1,610
		2,000,000	1,050	1,260	1,670

## SIGNALLING AND COMMUNICATION SYSTEM—RACEWAY SIZES FOR TWISTED PAIRS AND SINGLE CONDUCTORS

Size Raceway	Minimum Radius of Bends Inches	Number of Twisted Pairs No. 19 gage	Number of R. C. Single Conductors		
			No. 18 gage Fixture Wire	No. 16 gage Fixture Wire	No. 14 gage
1/2 in.	5	3	10	5	4
3/4 in.	6	6	16	9	7

No run of raceway to exceed 100 ft. in length or to include more than two 90-degree bends.

## RACEWAY SIZES FOR LEAD-COVERED TELEPHONE CABLES, NO. 22 CONDUCTORS (OR NOT OVER FOUR NO. 18 CONDUCTORS)

Number of Pairs	Trade Size Raceway Inches	Minimum Radius of Bends Inches	Number of Pairs	Trade Size Raceway Inches	Minimum Radius of Bends Inches
10 or less	1 1/4	6	51 to 100	1 1/2	12
11 to 25	1 1/2	8	101 to 200	2	12
26 to 50	1 3/4	12	201 to 400	3 1/2	18

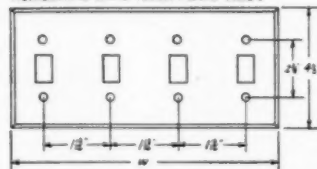
No run of raceway to exceed 100 ft. in length or to include more than two 90-degree bends.

## ELECTRICAL METALLIC TUBING—WEIGHTS AND DIMENSIONS

Size, inches	Approximate weight per 1000 ft., pounds	Diameter, inches	
		Internal	External
1/2	254	0.493	0.577
3/4	321	0.622	0.706
1	485	0.824	0.922
1 1/4	711	1.049	1.183
1 1/2	985	1.380	1.508
2	1141	1.610	1.738
	1470	2.067	2.195

## PLATE SIZES

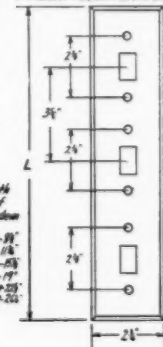
### HORIZONTAL GANG FLUSH PLATE SIZES



W-Plate width for different number of gangs

- 1 Gang - 2 1/4"
- 2 Gang - 4 1/4"
- 3 Gang - 6 1/4"
- 4 Gang - 8 1/4"
- 5 Gang - 10"
- 6 Gang - 11 1/4"
- 7 Gang - 13 1/4"
- 8 Gang - 15 1/4"

### TANDER FLUSH PLATE SIZES



L-Plate length for number of devices in tandem

- 2 Gang tandem - 31"
- 3 Gang tandem - 38"
- 4 Gang tandem - 45"
- 5 Gang tandem - 52"
- 6 Gang tandem - 59"
- 7 Gang tandem - 66"



# ENGINEERING DATA

## VOLTAGE DROP TABLE

1. To find the size of wire required for a given voltage drop stated in percentage of the line voltage:  
Find the "ampere-feet" by multiplying the current in amperes by the length of one wire in feet (not the total length of wire in the circuit).  
Find the line voltage in the upper left corner; follow this horizontal line to the right to the given per cent drop; follow this column down to the number of ampere-feet nearest to the actual number calculated. Follow this horizontal line to the left.

The required size is the size found on this line.  
2. To find the per cent voltage drop which will be produced by a given size of wire:  
Find the ampere-feet as above.  
Starting with the given size of wire follow this horizontal line to the right to the number of ampere-feet nearest to the actual number calculated. Follow this column up to the per cent drop on the line corresponding to the line voltage.

Volts		PER CENT DROP									
550	4	2	1.5	1.4	1.2	1.0	0.8	0.6	0.4		
440	5	2.5	2	1.75	1.5	1.25	1	0.75	0.5		
220	10	5	4	3.5	3	2.5	2	1.5	1	0.75	0.5
110	20	10	8	7	6	5	4	3	2	1.5	1
SIZE OF WIRE		AMPERES-Feet (AMPS. X SINGLE DISTANCE IN FEET)									
14			1,670	1,460	1,250	1,050	840	630	420	310	210
12			2,660	2,320	1,990	1,660	1,330	1,000	670	500	330
10	10,000	5,300	4,200	3,700	3,170	2,650	2,120	1,590	1,060	790	530
8	16,000	8,480	6,700	5,900	5,000	4,200	3,400	2,520	1,680	1,240	840
6	26,700	13,400	10,700	9,400	8,000	6,700	5,300	4,000	2,670	2,010	1,340
5	33,700	16,930	13,500	11,800	10,100	8,400	6,700	5,100	3,370	2,530	1,690
4	42,500	21,300	17,000	14,900	12,800	10,600	8,500	6,400	4,300	3,200	2,130
3	53,600	26,800	21,400	18,800	16,100	13,400	10,700	8,000	5,400	4,000	2,680
2	67,600	33,800	27,000	23,700	20,300	16,900	13,500	10,100	6,800	5,100	3,400
1	85,200	42,600	34,100	29,800	25,600	21,300	17,000	12,800	8,500	6,400	4,300
0	107,500	53,600	43,100	37,600	32,300	26,900	21,500	16,100	10,800	8,100	5,400
000	135,500	67,600	54,200	47,400	40,700	33,900	27,100	20,300	13,600	10,200	6,800
000	170,900	85,500	68,400	59,800	51,300	42,700	34,200	25,600	17,100	12,800	8,500
0000	215,500	107,800	86,200	75,400	64,700	53,900	43,100	32,300	21,600	16,200	10,800
250,000 c.m.	254,600	127,300	101,900	89,100	76,400	63,700	50,900	38,200	25,500	19,100	12,700
300,000 c.m.	305,600	152,800	122,200	106,900	91,700	76,400	61,100	45,800	30,600	22,900	15,300
350,000 c.m.	356,500	178,200	142,600	124,900	106,900	89,100	71,300	53,500	35,600	26,700	17,800
400,000 c.m.	407,400	203,700	163,000	142,600	122,200	101,900	81,500	61,100	40,700	30,600	20,400
450,000 c.m.	458,300	229,200	183,300	160,400	137,500	114,600	91,700	68,700	45,800	34,400	22,900
500,000 c.m.	509,300	254,600	203,700	178,200	152,800	127,300	101,900	78,400	50,900	38,200	25,500

## HAZARDOUS LOCATIONS CLASSIFIED

### Class I

Class I locations are those in which flammable volatile liquids, highly inflammable gases, mixtures or other highly flammable substances are manufactured, used, handled, or stored in other than their original containers.

Dry Cleaning Plants  
Petroleum Refineries  
Bulk Oil Stations  
Filling Stations  
Gas Plants  
Spray Painting Establishments  
Dip Tank Painting Processes  
Chemical Mills  
Artificial Silk Factories  
Pyroxylin Plastic Factories  
Fabric and Paper Coating Plants  
Rubber Industry  
Leather and Shoe Industry  
Hospitals  
Soap Factories  
Rotogravure Print Shops  
Oil Cloth Factories  
Hat Manufacturers  
Distilleries  
Liquor Rectifying or Blending Plants  
Wall Paper Factories  
Nitro-Cellulose Film Storages  
Booster Stations on Oil Lines  
Booster Stations on Gas Lines  
Pharmaceutical Manufacturing Plants  
Oil Rigs in Oil Fields  
Paint and Varnish Factories  
Dye and Color Manufacturing Plants  
Wood Distillation Plants  
Vegetable Oil Mills using Solvent Extraction Processes  
Linoleum Factories  
Bulk Compressed Gas Stations

### Oiled Clothing Factories

Airplane Factories and Repair Shops

### Class II

Class II locations are those in which (1) combustible dust is thrown, or is likely to be thrown, into suspension in the air in sufficient quantities to produce explosive mixtures, or (2) those where it is impracticable to prevent such combustible dust from collecting in such quantities on or in motors, lamps, or other electrical devices that they are likely to become overheated because normal radiation is prevented.

Grain Elevators  
Flour Mills  
Feed Mills  
Rice Mills  
Corn Starch Plants  
Coal Elevators  
Wood Working Plants  
Cork Pulverizing Plants  
Sugar Refineries  
Metal Dust Processes  
Spice Mills  
Pulverizing Plants  
Cocoa  
Sulphur  
Hard Rubber  
Dried Milk  
Soap  
Breweries  
Distilleries  
Malting Plants  
Alfalfa Mills  
Wood Flour Factories  
Chemical Plants (Grinding Processes)  
Candy Factories (Starch Rooms)  
Snuff Manufacturing Plants

### Classes III and IV

Class III locations are those in which easily ignitable fibres or materials producing combustible flyings are handled, manufactured or used, and which are hazardous through such fibres or flyings collecting on or being ignited by arcing contacts, resistors, lamps or similar apparatus.

Class IV locations are those in which easily ignitable combustible fibres are stored or handled (except in rooms where in process of manufacture) and which are hazardous through such fibres being ignited by arcing contacts, resistors, lamps, or similar apparatus.

Cotton Gins  
Cotton Compresses  
Cotton Mills  
Cotton Seed Oil Mills  
Upholstery Establishments  
Mattress Factories  
Carpet Factories  
Combustible Fibre Warehouses  
Bag Factories  
Rope Factories  
Waste Paper Warehouses  
Combustible Fibre Warehouses, storing:  
Cotton  
Sisal or Henequen  
Ixtle  
Jute  
Hemp  
Spanish Moss  
Tow  
Coco Fibre  
Oakum  
Baled Waste  
Kapok  
Excelsior

# LOAD DATA TABLES

## ENGINEERING DATA

Appliance, Device or Machine	Domestic			Commercial Industrial			Domestic			Commercial Industrial		
	Watts	Kilo Watts	Horse Power	Watts	Kilo Watts	Horse Power	Watts	Kilo Watts	Horse Power	Watts	Kilo Watts	Horse Power
	From To	From To	From To	From To	From To	From To	From To	From To	From To	From To	From To	From To
<b>LIGHTING EQUIPMENT</b>												
Aisle and Seat Floods.....	25-40			25-40	3-10							
Blue Printing.....				200-2500								
Borderlights, Prof. Stage, per ft.....				100-500								
Borderlights, Schools, per ft.....				200-500								
Color Matching, Store Counter.....				500-3000								
Color Matching, Studio & Laboratory.....				75-500								
Cove Strips, per ft.....	40-200			40-150								
Exit Signs.....				200-1500								
Floodlights, Outdoor.....	60-500			100-1000								
Floodlights, Window.....				100-300								
Footlights, Prof. Stage, per ft.....				100-1000								
Footlights, Schools, per ft.....				100-300								
Hair Drying.....	100-300			30-40								
Luminaire lamps, per 18-in. length.....	30-60			-40								
Luminaire lamps, per 12-in. length.....	-40			100-1500								
Luminaires (Commercial Lighting Fixtures).....				8-12								
Luminous Tubing (Neon) per ft.....												
Photostat Machines.....												
Projectors, Amateur Movie.....	250-500											
Projectors, Amateur Movie and Sound.....	400-1000											
Projectors, Prof. Movie—(31-V).....												
Projectors, Visual Lecturing.....												
Reflector, Show Case, per ft.....												
Reflector, Show Window, per ft.....												
Spotlights Ball Room.....	100-500											
Spotlights Projection Booth—(55-V).....												
Spotlights Stage or Balcony Rail.....												
Spotlights Show Windows.....												
Spotlights Statuary (Residence).....												
Three-Element Lamps, Smallest Size.....	25-300											
Three-Element Lamps, Largest Size.....	50/100/150											
Vapor, Mercury, High Intens., Screw Base.....	100/200/300											
Vapor, Mercury, Low Intens., Spec. Tubular.....												
Vapor, Sodium.....												
<b>ELECTRICALLY HEATED EQUIPMENT</b>												
Caseroles.....	100-425											
Cookers, Egg.....	350-600											
Cookers, Food.....	125-1000											
Dishes, Chafing.....	160-660											
Driers, Clothes.....	350-5000											
Driers, Hair.....	35-550											
Fireplaces, Artificial.....	-1150											
Friers, Deep Fat.....												
Heaters, Air.....												
Heaters, Aquarium.....	50-100											
Heaters, Chick Brooder.....												
Heaters, Chick Hatchery.....												
Heaters, Curling Iron.....												
Heaters, Immersion Typ.....												
Heaters, Permanent Wire Mach.....												
Heaters, Soil per 60-ft. & 120-ft. Lengths.....	400-500											
Heaters, Organ Chamber.....												
Refrigerators.....												
Saws, Band (Home Work Shop).....												
Sharpeners, Razor Blade.....												

# ENGINEERING DATA

Description	Capacity	Power	Voltage	Current	Speed	Weight	Material	Notes	References
Pumps, Vacuum.	2-5								
Razors, Electric.	2-5								
Refrigerators.	1/2-2								
Saws, Band (Home Work Shop).	15-30								
Sharpeners, Razor Blade.	1/2-1 1/2								
Softeners, Water.	1/2-1 1/2								
Sprayers, Paint & Insecticide.	1/2-1 1/2								
Stage, Curtain Control Motor.	15-25								
Stage, Orchestra Lift.	3-7 1/2								
Stokers, Coal.	1/2-5								
Trains, Toy.	3-10								
Tumblers, Laundry Drying.	1/2-1 1/2								
Vibrators, Massage.	1/2-1 1/2								
Washers, Clothes.	1/2-1 1/2								
Washers, Dish.	1/2-1 1/2								
Washers, Steam Laundry.	3-15								
MAGNETS, RECTIFIERS, TRANSFORMERS									
Chargers, Battery.	600-750								
Closers, Window, Magnetic.	500-1000								
Dia-Thermis, Therapeutic.	6-9								
Door Locks, Apt. House.	50-250								
Electrocuters, Insect.									
Electroplating.									
Furnaces, Induction.									
Magnets, Lifting Metal.	5-20								
Magnets, Metal Extracting & Separator.	5-500								
Ozonators, Room Air Purific.	4-15								
School Experimental Laboratory Panels.	1 1/2-5								
Sterilizers, Water Violet Ray.	5-50								
Transformers, Residence Bell Ringing.									
Transformers, Miscell. Signal Systems.									
Valves, Gas & Liquids, 1-in. & Less.									
Valves, Above 1-in.									
Welders, Light Duty Spot & Arc.	3-20								
Welders, Heavy Duty & Arc.	20-100								
X-Ray—Dental & Doctor.	2-25								
X-Ray Hospital.	10-40								
ALARM AND SIGNALLING EQUIPMENT									
Alarms, Burglar, Residence 1 to 5 Signal.	10-60								
Alarms, Burglar Other Systems.	10-60								
Alarms, Fire Residence 1 to 5 Signal.	1.8-2.4								
Alarms, Fire Other Systems.	-10								
Amplifiers, Radio Distribution.	5-10								
Annunciators, Homes 5/8 to 2 1/2-in. Lamps, Each.									
Annunciators, Large Systems—(110-Volt Lamps, Ea.)									
Bells, 2 1/2-in. to 4-in.									
Bells, Larger.									
Bells, Church Systems.									
Buzzers.									
Chimes, Door Single and Multiple-Tone.	5-6								
Chimes, Church Systems.	15-25								
Clocks, Master Impulse.	1-2								
Clocks, Secondary Type—(24-Volt).	5-1								
Gongs, Horns, Howlers.	10-30								
Radio, Amateur Transmitting.	100-1000								
Radio, Home Receivers.	45-150								
Sirens, Small & Heavy-duty.									
Speakers, Loud.									
Whistles, Air Valve.	4-10								
Whistles, Motor Compressor.									
MOTOR-OPERATED EQUIPMENT									
Blowers, Organ.	2-7 1/2								
Blowers, Pneumatic Tube Systems.	10-30								
Blowers, Portable Machine Cleaning.	1/2-3								
Boilers, Oil Burning.	1/2-3								
Burners, Oil.	1/2-3								
Cash Registers.	1/2-3								
Churns, Butter.	1/2-3								
Cleaners, Vacuum Built-in.	1/2-3								
Cleaners, Vacuum (Hand Type) Portable.	1/2-3								
Cleaners, Hedge.	1/2-3								
Clocks, Motor Operated, Large Types.	1/2-3								
Compressors, Air (Gasoline Station).	1/2-3								
Compressors, Air (Temp. Regul. System).	1/2-3								
Compressors, Refrigeration.	1/2-3								
Conditioners, Air (Room Types).	1/2-3								
Coolers, Water.	1/2-3								
Cranes, Travelling Lift.	1/2-3								
Cranes, Travelling Bridge.	1/2-3								
Dimmer Lever Drives.	1/2-3								
Dental Chair Units.	1/2-3								
Door Openers, Private Garage.	1/2-3								
Door Openers, Shipping Docks.	1/2-3								
Drills, Portable 1/2 to 3/4-in.	1/2-3								
Drills, Portable 3/4 & larger.	1/2-3								
Dumbwaiters.	1/2-3								
Elevators, 1-Ton Freight.	1/2-3								



# Universal Panelboard Reference Form

When Standard Panelboards, as listed in manufacturer's catalogues, do not fully meet the complete requirements of a particular purpose, or when Special Distribution Panelboards are required, the following references will be of aid in specifying the necessary features desired.

## 1. SERVICE CONNECTIONS

- A. Private plant or Public utility
- B. Outside source
  - 1. Overhead, or
  - 2. Underground
- C. Indoor source
  - 1. Private sub-station
  - 2. Utility sub-station
  - 3. Private plant switchboard
- D. Various wiring systems employed
- E. System characteristics (Specify details of each)
  - 1. Voltage
  - 2. DC, or Cycles and Phase
  - 3. Feeder System, 2-3-4-5 or 7 Poles
  - 4. Neutral or grounded phase wire

## 2. METERING PROVISIONS

- A. Separate from panelboard equipment
- B. Integral with main distribution panelboards
- C. Transformer or self-contained metering
- D. Systems metered
  - 1. Sub-meters
  - 2. Demand-Power Factor-Offpeak, etc.

## 3. MAIN CONNECTIONS TO PANELBOARDS—GENERAL TYPES

- A. Bare bus-bar riser systems
  - 1. Rectangular solid bars, or
  - 2. Round solid bars, or
  - 3. Hollow tubing
  - 4. Give exact details or design
- B. Lugs only
  - 1. Solder type, or
  - 2. Solderless connectors
- C. Fuse only mains
  - 1. Live face, or
  - 2. Dead front, or
  - 3. Safety disconnect
  - 4. Convertible—Non-convertible
- D. Externally operable switch
  - 1. Fusible, or
  - 2. Non-fusible
  - 3. Fusible, with safety interlocking fuse compartment
- E. Automatic circuit breaker
  - 1. Air break, or
  - 2. Oil break
  - 3. Specify number breaker poles—Number trip coils—Other protective features desired
- F. Remote controlled contactor
  - 1. Fusible—Non-fusible
  - 2. Latched-in, or magnetically held
  - 3. Number and type of control stations
- G. General References:
  - 1. Select type main connections desired for each branch or distribution panel
  - 2. Ampere rating required
  - 3. Number grounded and un-grounded poles
  - 4. Neutral or grounded phase terminals for all controlled conductors
  - 5. Size and number conductors per pole
  - 6. Size feeder conduit
  - 7. Mains Connect at
    - Top-Bottom, or
    - Left-Right sides of panel

## 4. BRANCH CIRCUITS—LIGHTING and/or APPLIANCES

- A. Type circuits employed
  - 1. 2-wire, 2-fuse, or
  - 2. 2-wire, Solid neutral, or
  - 3. 3-wire, Solid neutral
- B. Circuit control and protection
  - 1. Plug type fuse connections only, or
  - 2. Tumbler switches—1, 2, 3-pole, or 3-way, with
    - a. Plug fuse connections, or
    - b. N. E. C. cartridge type fuse connections
  - 3. Automatic circuit breakers—1, 2, or 3-pole
    - a. 15-amp. trip, or
    - b. Up to 50-amp., as specified
  - 4. Sub-master controls for groups of sectionalized circuits as specified
    - a. Manual control—Type and capacity
    - b. Remote controlled—Type and capacity
    - c. Bussed to sub-master—Gutter jumpers
  - 5. Neutral terminal bus
- C. General Reference:
  - 1. Designate for each panel such circuits as are of special capacity or design
  - 2. Specify total number of circuits including spares
  - 3. Assign each panel a number or alphabetical designation

## 5. SPECIAL FEATURES—BRANCH PANELBOARDS (See Catalogue Illustrations)

- A. Extra mains—Above or larger than Catalog Standard.
- B. Sub-feeders
  - 1. Number desired; size of each and type
    - a. Feed-through lugs only
    - b. Fuse connections only (Type)
    - c. Switch and fuse (Type)
  - 2. Check carefully required increase of main bus capacity
- C. Split or Sectionalized main busses (By sketch or detailed description)
  - 1. Type connections for each group
  - 2. Bussed, or gutter jumpers
- D. Blank Spaces for future features or equipment

## 6. SPECIAL DISTRIBUTION PANELBOARD CIRCUITS

(For feeders, sub-feeders and motors)

- A. Live face or dead front
- B. Convertible or non-convertible
- C. Fuse connections only, or
- D. Fusible switches
  - 1. Knife (Live face), or
  - 2. Pull-out or hinged type combination fuse and disconnect, or
  - 3. Tumbler—(60-amp., 250-V max. capacity), or
  - 4. Brush—other safety type
    - a. Non-interlocking, or
    - b. Safety type interlocking fuse compartment cover
- E. Circuit breakers—Air or oil-break.
  - 1. Number poles
  - 2. Number trips
  - 3. Range calibration
  - 4. Remote tripping circuits
  - 5. Special protective features
  - 6. Number and capacity spare spaces
- F. Blank spaces for future
  - Specify amperes for each



## ENGINEERING DATA

- G. State system characteristics  
(See Reference I-E)
- H. Determine ampere capacities from careful checking
- I. Name or number each panel

### 7. DESIGNS FOR SPECIAL DISTRIBUTION PANELS

- A. Small or medium sizes—(Few branches-moderate capacities)
  - 1. Tall and narrow panel, with single branch-busses vertical
    - a. Left-right hand main busses
    - b. Top-bottom main connections
  - 2. Medium proportion panel, with double branch-busses vertical near center
    - a. Mains top-bottom
  - 3. Low, wide panel, with single branch-busses horizontal
    - a. Left-right hand main connections
    - b. Special door construction
  - 4. Limited space, ample depth
    - a. Rear or side access compartments
- B. Large sizes—(Large number circuits-assorted capacities)
  - 1. One large cabinet—One panel
  - 2. One large cabinet—Two or more panels
    - a. Jumpered, inter-connected mains, or
    - b. Multiple main feeders
    - c. Main connections each panel—State size
  - 3. Special shaped cabinets
    - a. L shaped—U shaped or back to back
    - b. Jumpered or bussed panel inter-connections
  - 4. Separate cabinets—Separate panels
  - 5. Specify space limitations, if crowded
  - 6. Check size of room openings for box delivery
  - 7. Check proximity of main connections in relation to
    - a. Service entrance
    - b. Service switch or breaker
    - c. Current transformers  
(For cable length economy)
  - 8. Arrange multiple panels and major conduits to minimize cable crossings in gutters

### 8. BUS-BAR CONNECTIONS

- A. Face of panel, or in rear of panel
- B. Meter loops bussed to gutter
- C. Current transformer connections
  - 1. Busses to gutter, or
  - 2. Bus connected to panel-mounted transformers, front or rear
- D. Miscellaneous connections
  - 1. Resistors—Contactors, Relays  
(Give full details)
- E. Sectionalized panel groups  
(Sketch or details)

### 9. PANEL MATERIALS

- A. Slate-Marble-Ebony Asbestos
- B. Moulded composition units
- C. Steel or composition blanks and covers
- D. Finish or color

### 10. COPPER FINISHES

- A. Standard satin finish, or
- B. Special polished copper, or
- C. Special draw file

### 11. SWITCH AND FUSE CONSTRUCTION

- A. Manufacturer's standard, or
- B. Special type "A"
- C. Quick break attachments
- D. Special fuse jaw tension clamps

### 12. NAME PLATES—CARD HOLDERS

- A. Manufacturer's standard design, or
- B. Special etched copper per detail
- C. Special card holders per detail

### 13. CABINETS FOR BRANCH OR DISTRIBUTION PANELBOARDS

- A. Standard general duty, or
  - 1. Weatherproof/tight—Dampproof/tight—Dust-proof/tight
  - 2. Vaporproof/tight—Waterproof/tight
  - 3. Give details if particular design desired
  - 4. Gaskets standard, unless otherwise stated

- B. Finish—Manufacturer's standard, or
  - 1. Plain steel, black japan, lacquer,  
Special paint, specify in detail
  - 2. Galvanized sheet, or Hot-dipped galvanized, or cadmium plated

- C. Specify separately for box and trim if different

#### D. Boxes only:

- 1. Gauge—Standard, or special gauge—\_\_\_\_\_ inches
- 2. Gutters—Standard, or special size—\_\_\_\_\_ inches
  - a. All around, or sides only
  - b. Top and/or bottom
- 3. Depth—Standard, or special depth—\_\_\_\_\_ inches
- 4. Extra features—Give details or sketch
  - a. Junction space
  - b. Compartments—dividers
  - c. Cable racks—Terminal blocks
  - d. Side doors—Side plates
  - e. Ventilating grilles
  - f. Special reinforcing members
  - g. Sectional—Assemble at job
- 5. Drillings—Standard catalogue, or  
Special template from customer
- 6. Space Limitations—Unlimited, or
  - a. Maximum depth available—\_\_\_\_\_
  - b. Maximum width available—\_\_\_\_\_
  - c. Maximum height available—\_\_\_\_\_

#### E. Front only

- 1. Manufacturer's Standard, or
  - a. Special attachment to box—\_\_\_\_\_
- 2. Gauge—Standard, or special gauge—\_\_\_\_\_
- 3. Standard single door, or door-in-door  
(Branch circuit panelboards)
- 4. Solid, or sectional trim
- 5. Special trim drillings
  - a. Meter loop bushings (Give detail)
  - b. Pilot receptacles—Bracket lights
  - c. Miscellaneous control switches
- 6. Special door construction
  - a. Split doors
  - b. Double-triple—Jack-knife
  - c. Special swing per details
- 7. Hardware—Standard, or special:
  - Vault handles, Shoot bolts
  - Knobs, Locks, Plating, Directory
  - Frames, Card Holders, Name plates
  - Always furnished to manufacturer's standard design, unless otherwise specified in detail

### 14. FOREIGN APPARATUS OR EQUIPMENT

- A. Time clocks—Contactors—Relays—Control switches—Fuses—Resistors—Instruments—Metering transformers, etc.
- B. How Furnished:
  - 1. By manufacturer and built in at factory, or
  - 2. By others, shipped to, and built in at factory, or
  - 3. By manufacturer, shipped to job, and installed in panels per template, after panels are set
  - 4. Furnished and shipped to job, by others; factory to make provisions for, from templates furnished
  - 5. Furnished by manufacturer but mounted separately from panels
- C. Details of Apparatus or Equipment
  - 1. Supply Make—Type—Dimensions or detail prints
  - 2. Specify panels in which to be installed

### 15. PRODUCTION AND SHIPMENT

- A. Shop Drawings
  - 1. Number required and date wanted—\_\_\_\_\_
  - 2. Submit upon completion to—\_\_\_\_\_
  - 3. None needed for standard panels—\_\_\_\_\_
  - 4. Typical prints for standard panels—\_\_\_\_\_
  - 5. In detail for panels—\_\_\_\_\_
  - 6. Special sections required for panel—\_\_\_\_\_ (describe detail needed)
  - 7. Connection diagram needed for panel—\_\_\_\_\_
- B. Production
  - 1. Defer until approval drawings, or
  - 2. Ship boxes at once—Panels will advise later
    - a. Use standard template for boxes—\_\_\_\_\_
    - b. Special templates attached for—\_\_\_\_\_
    - c. Special templates later for—\_\_\_\_\_
  - 3. Shipping Dates—Boxes—\_\_\_\_\_ Via—\_\_\_\_\_
    - Panels—\_\_\_\_\_ Via—\_\_\_\_\_
    - Froats—\_\_\_\_\_ Via—\_\_\_\_\_
    - Apparat.—\_\_\_\_\_ Via—\_\_\_\_\_

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# Advertisers' Product Index

ELECTRICAL CONTRACTING

JUNE, 1936

The listings under major product headings are of manufacturers advertising those products in this issue in sufficient detail to be of value to specifiers or users of those products.

It is recommended that manufacturers' advertisements listed under each product heading be referred to in order to get complete information.

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# MASTER WIRING MATERIALS AND ELECTRICAL EQUIPMENT SECTION

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GENERAL  ELECTRIC

WIRING SYSTEM DESIGNERS: SAVE TIME AND ASSURE CLIENT SATISFACTION

# KEEP THESE G-E MASTER WIRING MATERIALS PAGES BESIDE YOU

## AS YOU WRITE SPECIFICATIONS

### Here You'll Find Every Wiring Product You Need

The General Electric Company, Wiring Materials Division, congratulates *Electrical Contracting* for its splendid Master Specifications Issue. The comprehensive design procedure data, schematic drawings, master specifications, wiring standards, engineering data, and check charts presented by the editors for various types of buildings will prove enormously helpful to architects, electrical engineers and electrical contractors when designing wiring systems. With this material you can rapidly lay out the wiring system and quickly specify every wiring item for practically any building.

Then you need only to write in the name of the manufacturer who makes the best wiring materials for each purpose.

**The Complete Line.** You can write in "General Electric" for every wiring item! You'll want to do so for two strong reasons. First, *only* General Electric makes a *complete* line of wiring materials. Thus you'll save all the delay and inconvenience of thumbing through many manufacturers' catalogs for the various wiring items required. From the G-E Wiring Materials illustrated and described on the following pages and in the G-E catalogs presented on page 14 of this section, you can select every product needed for your wiring systems.

**The Superior Advantages.** The second important reason for you to specify "General Electric" is that by doing so you'll provide your clients with the finest engineered wiring materials made. G-E Wiring Materials assure efficient operation of electrical equipment and convenient control of it. They are rugged and durable. What's more, electrical contractors like to install the G-E line because the various products are designed so that they are easily used with each other.

**The Materials.** Pages 3-10 of this G-E Master Wiring Materials and Electrical Equipment Section,

contain descriptions and illustrations of those G-E Wiring Materials items which you'll most frequently specify for construction of residential, commercial, industrial, and public buildings. When you've laid out the wiring system and it's time for you to specify the wiring materials by the manufacturer's name, consult these pages. Locate items you require, then write these General Electric products by name on your specifications. If you require additional information about the products, it's available in the G-E Conduit, Wire and Cable, and Wiring Device Catalogs described on page 14. Send for these catalogs if you do not have them.

**Radial Wiring.** Page 11 contains a diagram and description of the new General Electric Radial Wiring System. This material presents the outstanding advantages of this revolutionary new wiring system for residential buildings. Pages 12-14 contain Radial Wiring Check Lists which will enable you to specify all the wiring items needed in G-E Radial Wiring Systems.

**Special Rectifiers.** Page 15 presents General Electric Special Rectifiers which are used for telephone systems, fire alarm, clock, signal systems, etc.

**Insulating Materials.** On page 16 are descriptions and illustrations of various G-E Insulating Materials which electrical contractors use for installation and maintenance work.

**Motors, Transformers, etc.** Pages 17 and 18 present such G-E electrical equipment as Motors and Controls, Transformers, Time Switches, Floodlights, Switchgear, Industrial Heating Devices, etc.

Save time by using the General Electric Master Wiring Materials and Electrical Equipment Section. And assure that your client gets the most efficient, dependable and durable product!

For additional information concerning the products contained on pages 3-18, see your nearest G-E Merchandise Distributor, or write to Dept. K-686, General Electric Company, Bridgeport, Connecticut.

# GENERAL ELECTRIC

## WIRING MATERIALS

APPLIANCE AND MERCHANDISE DEPT., GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

G-E MASTER WIRING MATERIALS AND ELECTRICAL EQUIPMENT SECTION



## G-E WHITE PROTECTS PERMANENTLY



**HOT-DIPPED GALVANIZED**  
For permanent and maximum protection inside and out.

**MILD STEEL**      **GLYPTAL COATED**  
For easy bending and installation economy.      For extra long life and easy wire-pulling.

### G-E WHITE EXPLOSION-PROOF CONDUIT



G-E White Explosion-proof Conduit is made of the finest mild steel, hot-dipped galvanized, and is Glyptal-coated inside and out. G-E White resists heat, moisture, gas, acids. It is easy to install, economical.

### G-E BLACK WITH ENAMEL COATING



G-E Black Rigid Conduit is made from the same mild steel tube as is G-E White. The only difference is that G-E Black is treated with a protective coating of tough black enamel baked on at a high temperature.

A complete line of G-E Fittings is available for G-E Conduit installations.



BUSHING



STRAP



ELBOW

## G-E ELECTRICAL METALLIC TUBING INSTALLS EASILY



COUPLING

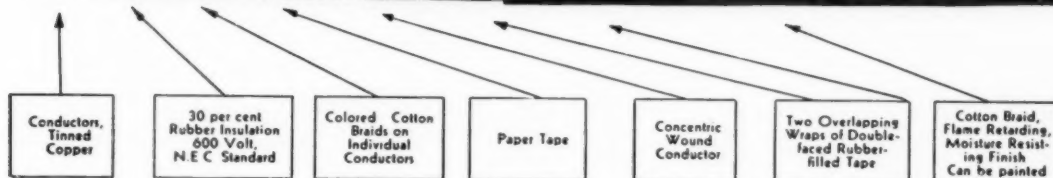


CONNECTOR

Where time is an important factor in wiring installations, G-E Electrical Metallic Tubing is ideal. It is light in weight, easy to bend, and requires no threading. It can be installed

easily and quickly. Compression couplings and connectors are available for joining lengths of the metallic tubing to each other or to outlet and junction boxes.

## G-E SERVICE ENTRANCE CABLES ENDURE

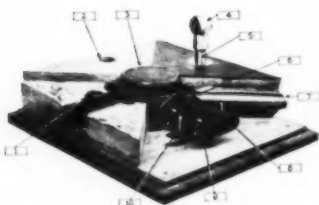


G-E Service Entrance Cable combines extreme flexibility with maximum mechanical protection. It is durable in all climates, and can be

painted. G-E Service Entrance Connectors of screw and threaded types, and G-E Aluminum Entrance Caps, assure snug installations.

## USE G-E FIBERDUCT IN LARGE BUILDINGS

Assures Wiring Flexibility for the Life of the Building



1. Adjustable insert readily threads itself into the duct.
2. Insert is firmly grouted into concrete floor.
3. Adjustable cover recessed to receive a section of the floor covering.
4. Gothic design, metal housed, insulated, telephone outlet.
5. Brass floor flange flush with linoleum.
6. The junction box is a substantial, one-piece casting.
7. "G-E White" for feeder lines.
8. "G-E Fiberduct."
9. Combination coupling and support.
10. Leveling screws, pointed at bottom, threaded the entire length.

G-E Fiberduct Underfloor Wiring Systems assure electrical outlets for all present and future needs. Outlets may be changed or added at any time. Unused outlets may be neatly capped until needed again. G-E Fiberduct is easy and economical to install. It adds to the building's appearance and convenience, and increases its value.



CROSS-SECTION OF  
CAT. No. 9000 DUCT

RIGHT, G-E  
FIBERDUCT BEING INSTALLED



## INSTALL G-E "BX" CABLE FOR TROUBLE-FREE SERVICE



"14-BX" WITH BUSHING



Cable  
Strap

"Squeeze"  
Connector

"Angle"  
Connector

G-E "BX" Cable is a round armored cable that meets the needs of a permanent installation, especially in residential work. Highly flexible, its armor, which is made of interlocking steel strip, heavily gal-

vanized, affords excellent mechanical protection for the Kraft-paper-covered moisture-proof, flame-retarding conductors. A complete line of fittings is available. They install easily and snugly.

## G-E BRAIDX NON-METALLIC SHEATHED CABLE



TWO-CONDUCTOR BRAIDX



Connector



Strap

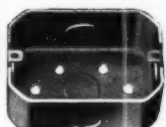
G-E BraidX Non-metallic Sheathed Cable consists of two or three insulated conductors with a special protective covering which resists mechanical injury. BraidX may be sup-

plied with an uninsulated copper conductor laid in next to the insulated conductors to be used for grounding purposes only. Necessary fittings are available.

## G-E BOXES ARE STURDY — INSTALL EASILY

Octagon Outlet Box  
With Cover

Utility Outlet Box With Cover



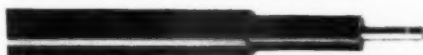
Switch Box

Extension  
Floor BoxLighting Outlet  
for Extension  
Floor Box

G-E Outlet, Switch and Floor Boxes reduce installation time and assure sturdy connections. Pryout knockouts are standard in many

of these boxes and the wide variety of covers permits the box to accommodate the specific installation requirement.

## USE G-E "SAFECOTE" BUILDING WIRES FOR EASY INSTALLATION AND LONG LIFE

Code Grade  
Black Rubber Insulation30% Performance Grade  
Green Rubber InsulationIntermediate Grade  
Red Rubber InsulationPerformite Grade  
Black Rubber Insulation

All four types of G-E Building Wires have close-fitting braids which do not fray or slip back, and have a flame-retarding and moisture-resisting finish designated as "Safecote."

**Four Grades.** G-E Building Wires are made in three commercial grades, which are Code, Intermediate, and 30% Performance. Another grade, designated as "Performite", meets special Federal building requirements.

**Code Grade Wire.** G-E Code Grade Insulation actually exceeds in tensile strength and electrical tests all of the requirements of the National Board of Fire Underwriters. A black rubber insulation permits easy identification.

**Intermediate Grade Wire,** with red rubber insulation, has physical and electrical characteristics superior to Code Grade insulation and proportionately longer life.

**30% Performance Grade,** with green rubber insulation, must pass oxygen bomb tests which are considered equal to approximately ten years of natural aging.

**Performite Grade Wire** is a long-life, super-aging insulation which meets the exacting requirements of Federal Specification JC 106. **Identification of Circuits.** G-E Building Wires can be supplied in six distinctive color braids to simplify circuit identification and testing.

## G-E LEAD-SHEATHED CABLE



One-Conductor

G-E Rubber- and Lead-sheathed Cables are particularly adapted for use where moisture, flames and steam environment may cause rapid deterioration of unprotected insulation.

## G-E PARKWAY CABLES



Type RLJFJ Parkway Cable

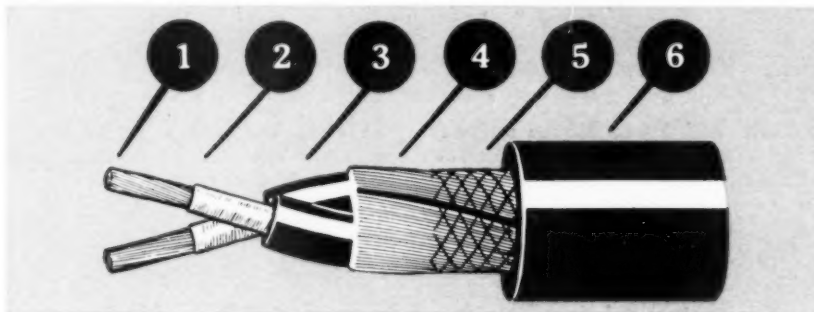
G-E Parkway Cables with rubber-covered conductors are used for underground service entrances and other underground distribution where cable is buried without use of conduits.

### OTHER G-E CABLES

Other G-E Cables used in buildings include High-voltage Distribution Cables, made with rubber, varnished cambric and paper insulations; Low-voltage Distribution Cables,

made with varnished cambric, paper and Glyptal cloth insulations, and rubber-insulated Control Cable. Asbestos-insulated Wires and Cables are on page 7.

## G-E "TYPE S" HEAVY-DUTY ALL-RUBBER CORD For Use Where Operating Conditions are Severe



1. Extra-flexible, multi-strand copper conductors assure long durable service with maximum flexibility.
2. Closed cotton wrap prevents corrosion of copper conductors.
3. 30% performance test rubber compound provides an insulation of high dielectric strength and long life.
4. Soft twine fillers act as a protective

- cushion for the insulated conductors and increase tensile strength of cord.
5. Open twine braid embedded in rubber provides extra reinforcement and strength. Prevents splitting of the jacket.
6. 60% pure rubber jacket compound, cured in lead, provides protection from abrasion and the destructive effects of oils, acids, and water.

G-E "Type S" All-rubber Cord provides dependable, uninterrupted service for heavy-duty electrical equipment in places where the cord is required to operate under severe con-

ditions. It has given entire satisfaction in thousands of factories, docks, railroad terminals, mines, etc. Approved by the Underwriters' Laboratories.

## G-E "TYPE K" PORTABLE CORDS FOR DAMP LOCATIONS



"TYPE K" PORTABLE CORD

G-E "Type K" Portable Cord is particularly designed as a pendant or portable in damp places, including breweries. The inner and

outer braids are impregnated with a weatherproofing compound. Approved by the Underwriters' Laboratories.

## USE G-E TELEPHONE WIRE FOR EXTENSIONS



TELEPHONE WIRE

G-E Telephone Wire is recommended for telephone extensions, signal systems, etc. Supplied

with a glazed cotton finish for indoor use, and a black weatherproof finish for exterior work.



## DELTABESTON ASBESTOS-INSULATED WIRES AND CABLES WITHSTAND EXTREME HEAT

Only Deltabeston Has **PURIFIED** Asbestos Insulation

Deltabeston Felted Asbestos Insulation resists heat, flame, oil, grease and corrosive vapors. Recently General Electric Deltabeston engineers developed *Purified* Asbestos (Spec. 723-391). *Purified* Asbestos, exclusive to Deltabeston, has given the line greater insulation

resistance, increased safety factor, and other advantages. Deltabeston Wires and Cables are made in a wide variety of types for industrial and commercial uses where the wiring is subjected to high temperatures. Some of these types follow:

POWER CABLE • FLEXIBLE APPARATUS CABLE • BOILER ROOM WIRE  
ELECTRIC STOVE AND RANGE WIRE • ELECTRIC RANGE CABLE • FIXTURE WIRE  
MAGNET WIRE • MOTION PICTURE MACHINE CABLE • ELEVATOR CONTROL CABLE  
FLEXIBLE CORDS • SWITCHBOARD WIRE • APPLIANCE LEAD WIRE

### DELTABESTON BOILER ROOM WIRES FOR 600-VOLT SERVICE

Recommended for open wiring in boiler rooms where a heat- and flame-proof installation is required. Will give permanent, uninterrupted service under constant high temperature.



A. V. C. INSULATION

### DELTABESTON FIRE-RESISTING ELEVATOR CONTROL CABLE



ELEVATOR CONTROL CABLE

Deltabeston Fire-resisting Elevator Control Cable withstands flame, heat, moisture, oil, and corrosive vapors. Building owners, elevator engineers and electrical engineers have enthusiastically approved it. Finished in any required length and any number of conductors up to and including 37.

### CONTRACTORS: WIND MOTORS WITH DELTABESTON MAGNET WIRE

Wind motors with Deltabeston Magnet Wire and you're certain to make a superior installation. Deltabeston's new *Purified* Asbestos Insulation has far greater dielectric strength, and is more resistant to heat, moisture, and acids than any other magnet wire insulation. In addition, the insulation is tougher, yet more flexible. It won't crack when the wire is bent at sharp angles.



ROUND

SQUARE

RECTANGULAR

## G-E SWITCHES ARE EFFICIENT, DURABLE

Made for Every Residential, Industrial and Commercial Requirement



PORCELAIN  
BOX  
FLUSH  
TUMBLER



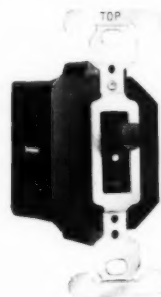
ENCLOSED  
FLUSH  
TUMBLER



HEAVY-DUTY  
FLUSH  
TUMBLER



FLUSH  
LOCKING  
TUMBLER

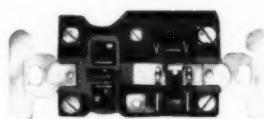


MERCURY  
BREAK  
FLUSH  
TUMBLER

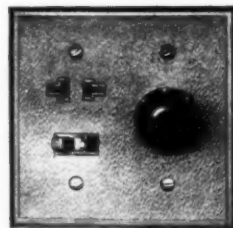


AUTOMATIC  
DOOR SWITCH  
For closets, etc.  
Opening door turns  
light on or off.

G-E Porcelain Box Flush Tumbler Switches are sturdy general purpose switches which should be specified where cost is a factor. The Enclosed Flush Tumbler type have their mechanisms completely enclosed and protected in a moulded compound or Textolite box. G-E Heavy-duty Switches are used on circuits up to 30-amperes capacity for power or heavy-duty service. G-E Locking Switches are operated by a key, thus limiting the control to authorized persons only. G-E Mercury-break Switches are noiseless. G-E Switch and Outlet Combinations in one device are designed for convenience and space-saving.



COMBINATION SWITCH AND  
CONVENIENCE OUTLET



COMBINATION SWITCH,  
PILOT LIGHT, AND CON-  
VENIENCE OUTLET

## G-E CONVENIENCE OUTLETS SERVE EVERY NEED



TOP-WIRED  
TWIN



SIDE-WIRED  
TWIN

G-E Convenience Outlets, made with sturdy brown Textolite bodies, have large binding screws and wide mounting ears for easy installation. Side-wired Twin Outlets have twin binding screws. Top-wired Outlets provide easily accessible binding screws. Double-duty Twin Outlets are for use where appliance must be grounded. Single Convenience Outlets may be used where only one appliance is semi-permanently installed, such as a refrigerator or dishwasher.



DOUBLE-DUTY  
TWIN



SINGLE  
OUTLET

## G-E HEAVY-DUTY PLUG RECEPTACLE WITH POLARITY CAP

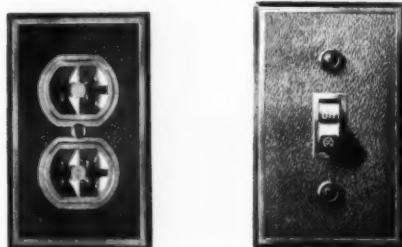


Plug Receptacle

Polarity Cap

G-E Heavy-duty Receptacles and Caps are designed to maintain the polarity of a circuit. They are used for connecting appliances, motors and devices on heavy-duty circuits. Furnished double-pole, three-pole, and four-pole.

## USE G-E FLUSH PLATES

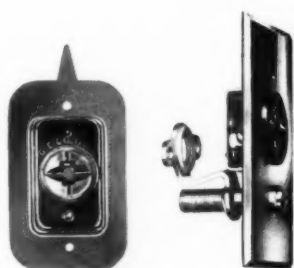


Outlet Plate

Switch Plate

G-E Flush Plates for convenience outlets, switches, and floor outlets are made of brass and Textolite in a variety of forms embracing all desired combinations.

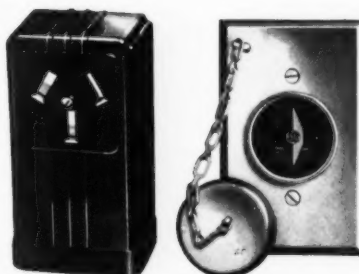
## A VARIETY OF G-E SPECIAL OUTLETS



Clock Hanger Outlet

Fan Hanger Outlet

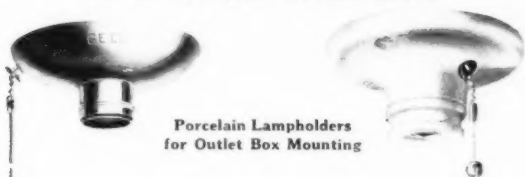
The G-E Flush Electric Wall Clock Hanger provides support and connections for an electric wall clock. Outlet is entirely concealed by the clock. G-E Fan Hanger Outlet serves a similar purpose for Fans. The G-E Range Outlet, a 50-ampere three-pole heavy-duty receptacle, when used with a G-E Range All-rubber Cord Set makes the electric range a portable appliance. G-E Outdoor Outlets with weatherproof cap for the appliance lead, permit outdoor use of appliances, floodlights, etc.



Range Outlet

Outdoor Outlet

## G-E LAMPHOLDERS



Porcelain Lampholders  
for Outlet Box Mounting

G-E Lampholders and Service Fixtures, made in porcelain, brass and Textolite, are available for use with all types of lamps and lighting fixtures.

## G-E LUMILINE LAMPHOLDERS



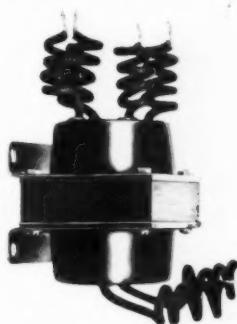
Single



Cap

## G-E BELL RINGING TRANSFORMERS

G-E Bell-ringing Transformers should be installed at the service entrance or at some convenient point to provide low voltage current for bell, buzzer and annunciator circuits.

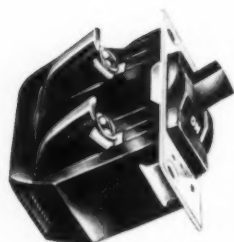


G-E 2334

100-watt transformer, 110-volt primary, 50 to 140 cycles. Secondaries, 4, 8, 12, 16, 20, or 24 volts. Will handle from five 10-inch bells to thirty 4-inch bells.

# PROTECT AND CONTROL EQUIPMENT WITH THE NEW G-E BRANCH-CIRCUIT CIRCUIT BREAKER

## Ideal for Residential and Commercial Buildings



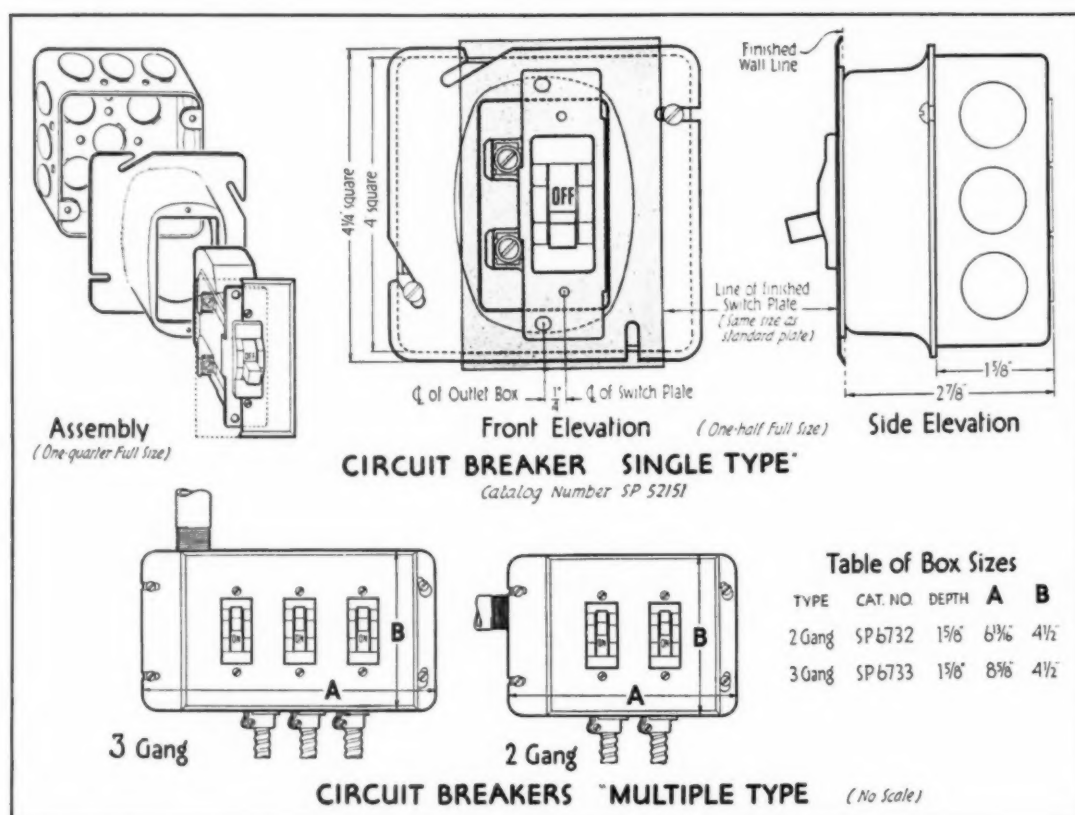
Breaker with Single Gang Brass Plate

occupants conveniently to restore service on branch circuits which have been "opened" by abnormal causes.

The new G-E Branch-circuit Circuit Breaker is an ideal device for wiring systems of homes, apartments, stores, offices, and other buildings. First, it positively protects branch circuits against overloads and short circuits. Second, it may be mounted flush in the wall in any location, resembling a neat tumbler switch, and permits

Thus it both protects and controls at the same point — adjacent to the lighting and appliances on the circuit. It's only necessary to flip the breaker's handle from its neutral position to "Off" and then "On" to renew the service once the trouble is removed. Anyone can operate this Circuit Breaker — and it eliminates all the delays and inconveniences involved in locating blown fuses in out-of-the-way places. Made in 15-, 20-, 25-, and 30-ampere capacities, single pole, 125 volts, a-c or d-c. Approved by Underwriters' Laboratories, Inc.

Specify the G-E Branch-circuit Circuit Breaker for wiring systems of the types described. Contractors: send for our special sales manual which presents effective methods for selling the new Breakers. Write for Publication No. 54-63.





## G-E RADIAL WIRING SYSTEM

### FULLY SATISFIES THE ELECTRICAL REQUIREMENTS OF MODERN HOMES

### Increases Wiring Conveniences - Reduces Voltage Losses - Provides for Future

To meet the increasing demands on residential wiring systems created by extensive electrical equipment, General Electric engineers have developed a revolutionary new wiring system. It has been built into all the G-E sponsored "New American" Homes.

**ITS ADVANTAGES** The General Electric Radial Wiring System offers many advantages to home owners. (It is also adaptable to other small buildings.) It is simple in design and construction. It reduces voltage losses to the minimum, making the current paid for do useful work without waste. It provides the efficient new G-E Branch-circuit Circuit Breakers at convenient points throughout the house. And when additions or changes in the wiring system are necessary in the future, they can be made easily and inexpensively.

**HOW IT FUNCTIONS** In the schematic drawing, you can see exactly how the G-E Radial Wiring System functions. The specifications call for an all-electric home with major fixed appliances and a complete outlet and lighting system with modern switching. The wires marked A designate the service entrance cables going through the meter to the Totalizing Unit in the cellar. For all-electric homes, these should never be less than three No. 4's. The circuit marked B is a sub-feeder to the range and water heater made up of not less than three No. 8 conductors properly fused at the Totalizing Unit. A load limiter in this circuit cuts off use of

water heater while range is in operation. The sub-feeder circuits C of No. 10 wires lead from Totalizing Unit A to the Air-conditioning Panel from which the air-conditioning equipment is run.

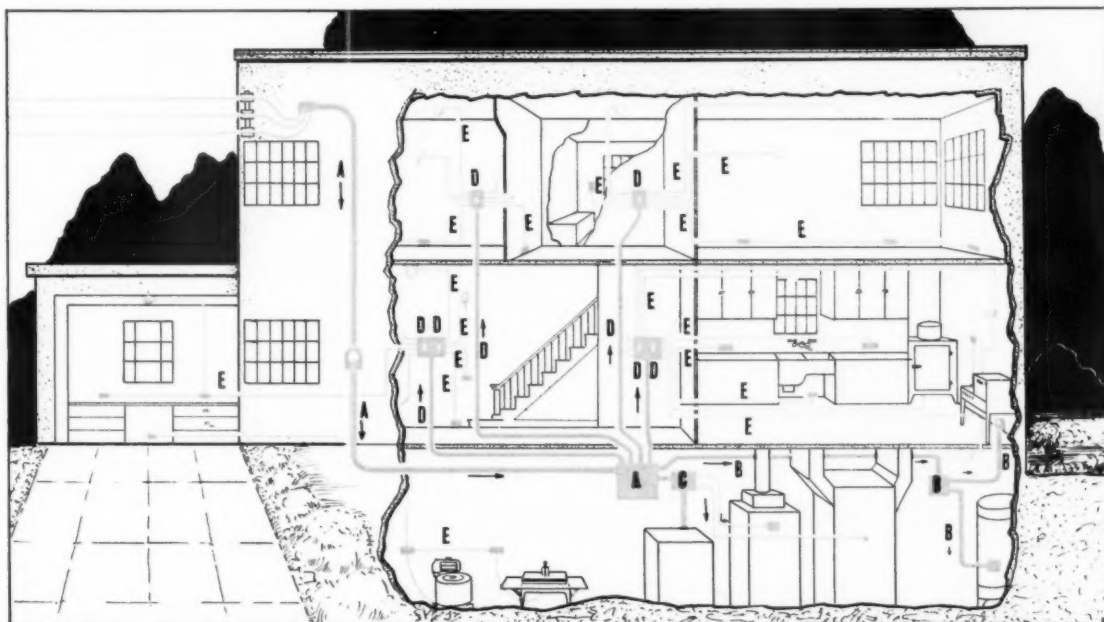
The risers, labeled D, consist of No. 10 conductors. They lead direct from the Totalizing Unit A to all Flush Branch-circuit Circuit Breakers. These Circuit Breakers or control units must be of suitable capacity to protect properly the wires which fan out into the various circuits over the house. You thus see that we have four points of sub-control conveniently located around the house.

The sub-circuits of No. 12 conductors, labeled E, are fanned out from the Circuit Breakers to the lighting or convenience outlets. Wherever possible, convenience outlets are circuited separately from lighting outlets.

The kitchen circuiting is particularly noteworthy. Appliance outlets are protected by a 20-ampere Circuit Breaker served by one of risers D. From it, sub-circuits are fanned out to individual appliance outlets. Thus each of the No. 12 wires is subjected to the load of only one outlet.

All details of course conform to the National Electrical Code requirements.

**SEND FOR MANUAL** A reference manual has been prepared giving detailed specifications of the G-E Radial Wiring System. It is listed by publication number on page 14 of this G-E Section. Send for a copy at once.



GENERAL ELECTRIC RADIAL WIRING SYSTEM

## G-E RADIAL WIRING SYSTEM — CHECK LIST

The following check list will serve as a reminder of the various conductors and raceways, and wiring devices, that may be needed in a residential wiring system. It establishes no mandatory requirements.

While prepared particularly for use in laying out G-E Radial Wiring Systems, the list may be used for any system. It should save time for architects, electrical engineers, and electrical contractors.

### CONDUCTORS AND RACEWAYS

MATERIAL SELECTION TABLE			
Structural Conditions and Locations	Raceway (Use designated conductor as noted)	Conductor (Used in raceway except as noted)	Armored or Non-Metallic Sheathed Cable (Used without raceway)
NON-FIREPROOF CONSTRUCTION			
1. General Light and Power Circuits			
Dry normal locations.	No raceway required by code for normal conditions. For highest grade installations, G-E Rigid Conduit (with G-E Flexible Conduit for special conditions) is recommended.  (Rigid Conduit may be required.)*	G-E Rubber Insulated Conductors.	G-E BX Cables, G-E BraidX Non-metallic Sheathed Cables and knob and tube work.
Damp normal locations.		G-E Lead-sheathed Cables.	G-E BXL Cables.
High temperature locations.		G-E Deltabeston Wires or Cables.	G-E Deltabeston Cables.
*Hazardous locations.		G-E Lead-sheathed Cables.*	G-E BXL Cables.
Concealed extensions.		G-E Rubber Covered Wires or Cables, lead-sheathed where required, in conduit.	G-E Oval BX or BXL Cables.
Surface extensions.	Alternate G-E BX and BXL Cables.		G-E BX or BXL Cables.
2. Low Voltage Circuits			
Bells, thermostats, etc.	No raceway required by code for normal conditions. G-E Rigid Conduit (with G-E Flexible Conduit, Metallic Tubing and Oval Duct for special conditions) in highest grade installations.	G-E Rubber Insulated Wires or Cables.	G-E BraidX Cables.
Public telephones.		Installed by Telephone Company.	Installed by Telephone Company.
Private telephones.		G-E Telephone Wires.	G-E Telephone Wires.
Protection, signaling and line voltage control devices.		G-E Rubber Insulated Wires or Cables in conduit.	G-E BraidX Cables without conduit. G-E BX Cable without conduit.
Radio wiring, shielded circuits.		G-E Rubber Insulated Conductors in conduit.	G-E BX or Lead-sheathed Wires or Cables with sheath grounded.
Radio wiring, non-shielded circuits.	No metallic conduit or sheathing permissible.	G-E Rubber Insulated Conductors.	G-E BraidX Non-metallic Sheathed Conductors or Cables.
*Consult requirements of National Electrical and local code for proper wiring for the particular hazardous condition at hand.			

\*Consult requirements of National Electrical and local code for proper wiring for the particular hazardous condition at hand.

### WIRING DEVICES

To avoid repetition in several parts of this check list, reference is made to the following rules:

**Rule 1.** Convenience outlets in rooms where arrangement of furniture and portable lights or appliances may vary with changing tenancy should be twin outlets located as follows. If located in baseboards, they should be spaced 6 ft. apart in each unbroken wall space more than 9 ft. long, with one outlet centered in unbroken walls more than 18" and less than 9 ft. long. If located in wainscots, 2 ft. or more above the floor, they should be spaced not over 8 feet apart in each unbroken wall more than 12 ft. long, with one outlet centered in each unbroken wall more than 18" and less than 12 feet long.

**Rule 2.** Convenience outlets in service areas, hallways, etc., should be located in accordance with Rule 1 on such wall areas as may receive furniture. On walls where portable furniture cannot stand, locate outlets as indicated by function of room,

providing at least one outlet for floor finishing or cleaning machine in each room.

**Rule 3.** "Step-Saver" switches (3-way and 4-way as required) should be provided in halls, stairways, or rooms having two or more doors, and on lighting circuits extending between buildings, to control at least one light source from each entrance-exit point. The objective shall be to permit continuous passage in either direction throughout, turning lights on and off without retracing steps.

**Rule 4.** Lighting outlets for installed fixtures should be provided in all rooms, whether or not portable lamps are chiefly used. Those not initially used may be covered with a blank flush cover. Good lighting practice demands general lighting in addition to local lighting. Provide one ceiling outlet in all areas having no dimensions greater than 15 ft.; two or more where any dimension exceeds 15 ft. Provide wall, bookcase, mirror or additional ceiling outlets where local or decorative lighting may be needed.

# G-E RADIAL WIRING SYSTEM — CHECK LIST

GE-11

LOCATION	CONVENIENCE OUTLETS	LIGHTING OUTLETS	SWITCHES AND CIRCUIT BREAKERS	SPECIAL OUTLETS
<b>GROUPS AND OUTBUILDINGS</b>				
Entrance Gate or Gate House		Ornamental lamps or gate light	Key-operated switch controlling driveway lights - 3-way	Push button for main or gate house bell; illuminated house number
Driveways and Walks		Street-type lights	See "Main Entrance Hall"	
Terraces and Gardens; Shelters, Garden Houses, Boat Houses, etc.	Outdoor outlets on walls, columns, etc., for portable garden lights, hedge clippers, etc.; and in shelters for appliances and portable lights.	Fixed garden lights Fountain and pool lights Fixed lights in shelters as required	3 or 4-way switches controlling lighting of adjacent areas and grounds with master control from main house	In shelters: Push button for main house annunciator Telephone outlets
Play Areas: Tennis Courts, Pools, Docks, etc.	See "Terraces," etc.	Floodlighting, as required; Dock and fixed landing lights; Under-water lighting.	See "Terraces"	See "Terraces"
Outbuildings: Garages, Barns, Greenhouses, Hotbeds, etc.	Outlets for battery chargers, portable tools and machinery, radios, heaters, etc.	Fixed entrance lights or floodlights	3 or 4-way switch control with master control from house	Telephone outlets Heavy-duty outlets
<b>RESIDENCE</b>				
Main and side entrances	Outdoor outlets for decorative lighting. See "Terraces"	Overhead or side	Locking switch for outside and vestibule lights - 3 or 4-way	Push button for door bell Illuminated house number
Service entrances		Overhead or side		Push button for door bell
Open porches	Outdoor outlets - See Rule 2	Overhead or side wall	Switch inside of door leading to porch	Push button for annunciator Telephone outlet plug
Main Entrance Hall, including Vestibule and Stair Hall For coat closet see "Closets" For powder-room or lavatory, see "Bathrooms"	See Rule 2 Clock hanger outlet Fan hanger outlet	See Rule 4	Single-pole, 3 or 4-way switches (see Rule 3) controlling lights in: Main Entrance (exterior) and Vestibule; Main, Upper and Stair Halls; Cellar Stairway (with pilot); Gardens, Driveway, Gates, etc. Flush Circuit breakers protecting sub-circuits in main living areas and all outside lighting circuits	Telephone outlet Organ or radio reproducer outlets
Main Living Rooms Library or Study Music Room Reception Room	Follow Rule 1 throughout Clock hanger outlet Fan hanger outlet Floor outlets for free standing tables, pianos, etc. Flush outlets in mantles, etc., for luminous ornaments	See Rule 4 Consider outlets for cove lighting, panel, beam, cornice and soffit lighting; "spot" or local lights for dominant features, paintings, etc.	Local control of fixed lighting outlets See also Rule 3 Consider switch control of one side of twin convenience outlets serving portable lights	Telephone connection Radio outlets Push button or pull cord for servants' annunciator Thermostat, humidistat or air-conditioning control
Dining Rooms and Breakfast Rooms	Follow Rule 2 Floor outlet under table Clock hanger outlet Fan hanger outlet	See Rule 4 Ceiling outlet over table essential	Control of fixed lighting outlets by 3 or 4-way switches at living and service entrances	Table or floor button to kitchen annunciator Telephone outlet plug Radio outlets
Enclosed Porches, Conservatories, etc.	See Rule 2 Fan hanger	See Rule 4	Local control switch at entrance	Push button for servants' call Telephone outlet plug Radio outlets
Kitchens, Pantries and Service Areas	Single outlets at refrigerator, dishwasher, garbage destructor Twin outlets (double-duty type) over all work tops Fan outlet - flush or hanger type Clock hanger outlet	Ceiling outlet supplemented by soffit lights at sink, range and work tops	Local switch control for each wall or soffit light Wall switch control of ceiling light (see Rule 3) Switch controlling kitchen ventilator fan Flush circuit breakers protecting all kitchen and service area sub-circuits	Special range outlet Special water heater outlet Annunciator box, bells and buzzers Telephone Radio outlet
Service Entrance Hall or Vestibule	See Rule 2	Ceiling outlet	Switch for vestibule light (see Rule 3) 3-way switches controlling service entrance lights and entrance lights at garage and adjacent outbuildings	
Halls, Stairs and Passageways	See Rule 2	See Rule 4	See Rule 3 Flush circuit breakers protecting branch sub-circuits serving adjacent areas	Telephone outlets Push buttons or pull cords to servants' annunciator
Master Bedrooms Dressing rooms Nurseries	Follow Rule 1 throughout Fan hanger outlet	See Rule 4 with special emphasis on side lights at mirrors, lights to illuminate wardrobes in dressing rooms and night light circuits	Consider silent (Mercury type) switches throughout, at least for night light circuits See also Rule 3 and "Protective Lighting" below	Heavy-duty outlet for radiant heater (fireplace or portable) Radio outlets Push button or pull cord to servants' annunciator Telephone outlets



# G-E RADIAL WIRING SYSTEM—CHECK LIST

LOCATION	CONVENIENCE OUTLETS	LIGHTING OUTLETS	SWITCHES AND CIRCUIT BREAKERS	SPECIAL OUTLETS
<b>RESIDENCE (CONTINUED)</b>				
Servants' Bedrooms	See Rule 1.	See Rule 4	Wall switch for lights	Night call bell House telephone
Bathrooms, Lavatories	Twin outlets at lavatory for toilet appliances Heavy-duty outlets (polarized) for radiant heater, sun lamps, etc.; out of reach of bathtub	Ceiling outlet Mirror lights Waterproof shower light Night light	Single-pole switches for lights Double-pole switches for heavy duty circuits; out of reach of the bathtub	Push button to servants annunciator Consider exhaust fan over shower or toilet compartment
Closets (all types)		Ceiling or side wall outlets	Automatic door switch or switch and pilot light on room side, or pull chain on light fixture	
Storerooms Attics Open Cellars	Twin outlets as required by size for vacuum cleaners, etc.	Ceiling or side wall as required for lighting all parts	Switches for all lights (with pilot if at door). See also Rule 3	
Utility Room Furnace and Equipment space	One or more for trouble lights, vacuum cleaner, repair tools, etc. (Preferably double-duty type)	Ceiling or side wall as required	Totalizing Unit, preferably with circuit breakers Flush circuit breaker for local branch sub-circuits if required Single-pole switches controlling all lights. See also Rule 3	Low voltage transformer Power outlet for invalid elevator, trunk lifts, etc. Power outlets for air conditioning equipment, oil burners, pumps, blowers, etc.
Laundry	Double-duty or heavy-duty outlets for washer, ironer, flat irons, dryer etc.	Ceiling outlet (general illumination) Lights over all fixed equipment	Single-pole controlling lights Double-pole as required for heavy-duty circuits	Exhaust fan outlet Extension call bell
Recreation Rooms Game Rooms	See Rule 2 Fan hanger outlet Clock hanger outlet	Ceiling or side for general illumination Special lighting for billiards, ping pong, etc.	Single-pole for general illumination Separate switches for special lighting See also Rule 3	Heavy-duty outlet for radiant heater (fireplace or portable) Telephone outlet Radio outlet Push button for servants' call
Work Rooms and Hobby Shops	Double-duty or heavy-duty with local switch control for all power machines, motors, etc.	See Rule 4 Special lights according to nature of equipment	Wall switches for general lights Pull switches for local lights	Ventilating fan House telephone

## SEND FOR THIS DESCRIPTIVE LITERATURE

Send for these publications in order to supplement the information presented on the preceding pages.

The Reference Manual for Architects and Engineers on Graded Wiring Systems establishes three grades of wiring systems for varying building requirements and offers short-cut methods for laying out and specifying any one of these systems.

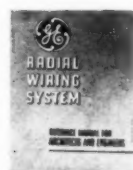
The Reference Manual for Architects and Engineers on the G-E Radial Wiring System presents detailed plans and information concerning this system and time-saving methods for laying out and specifying it.

The Conduit Products, Wire and Cable, Wiring Devices and Deltabeston Catalogs illustrate and describe all the products in these lines.

Order these publications by the titles listed to the right. Address Dept. K-686, Wiring Materials Section, General Electric Company, Bridgeport, Connecticut.



Architect's  
Manual



Radial Wiring  
System Manual



Conduit  
Products Catalog



Wire and Cable  
Catalog



Wiring Device  
Catalog



Deltabeston  
Catalog

# GENERAL ELECTRIC

WIRING MATERIALS

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONN.

## G-E MASTER WIRING MATERIALS AND ELECTRICAL EQUIPMENT SECTION



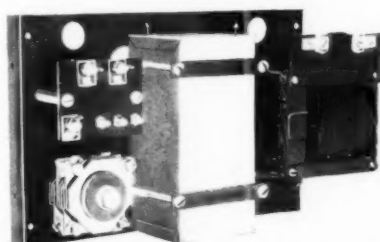
## PROVIDE G-E TUNGAR BATTERY CHARGERS AND COPPER OXIDE RECTIFIERS FOR LARGE BUILDINGS

Large buildings require rectifiers and battery chargers for the operation of internal telephone, fire alarm, clock, signal systems, etc. General Electric Tungar Battery Chargers and Copper Oxide Rectifiers provide efficient

and economical service of this type in thousands of apartments, hotels, office buildings, and factories. For additional information, write to Dept. K-686, Special Rectifiers Section, General Electric Co., Bridgeport, Conn.

### G-E COPPER OXIDE RECTIFIER

For Telephone Service



Model No. 6RC61D4 Copper Oxide Rectifier (Cover Removed)

This rectifier permanently replaces dry cells or storage batteries. It is designed to deliver a noiseless direct current of 6 volts, 0.350 amperes. Supplies power for interphone systems of apartments, schools, and many other buildings.

### G-E TUNGAR

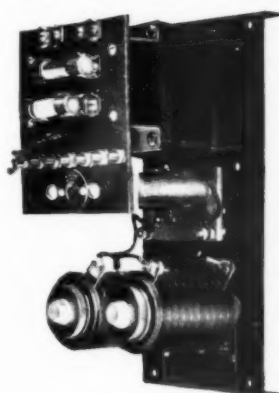
For Charging Clock, Signal Batteries, Etc.



Cat. No. 204170 and 199717 Tungar

This Tungar charges batteries of clock, signal, control systems, etc. It is a simple, compact half-wave outfit designed to charge from 9 to 12 cells at an adjustable rate 0.5 to 2.5 amperes. Supplied in a neat, rugged casing arranged for wall, panel or bench mounting.

## G-E COPPER OXIDE BATTERY CHARGERS FOR FIRE ALARM SYSTEMS



Model No. 6RC54D2 Copper Oxide Battery Charger

Low-priced and extremely efficient, these copper oxide rectifiers were developed by General Electric to meet an ever-growing demand for dependable trickle chargers for fire alarm batteries. Unusually economical in operation, this trickle charger keeps fire alarm batteries fully charged at all times.

LEFT: Dry type. Full fuse protection. No "standby" batteries required.

RIGHT: Dry type. Similar to No. 6RC54D2, except that this model is provided with a high grade D'Arsonval ammeter for indicating the charging rate.



Model No. 6RC75D1 Copper Oxide Battery Charger

# GENERAL ELECTRIC

SPECIAL RECTIFIERS

APPLIANCE AND MERCHANDISE DEPT., GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

## CONTRACTORS: G-E INSULATING MATERIALS HANDLE EASILY . . ASSURE LONG-LIFE INSTALLATIONS

Electrical contractors throughout the country use and approve G-E Insulating Materials. Contractors find them easy to handle and durable. A few of these materials are shown

below. For information on the complete line of G-E Insulating Materials, write to Dept. K-686, Insulating Materials Section, General Electric Company, Bridgeport, Connecticut.

### G-E TAPES



G-E Friction Tape won't dry up or ravel — it really *sticks*. G-E Rubber Tape can be moulded by the heat of the hand to form a water-tight insulated joint. G-E Varnished Cloth and Cotton Tapes likewise satisfy contractors and customers.

### G-E GLYPTAL RED



G-E No. 1201 Glyptal Red is extensively used as a protective coating on the windings of electrical apparatus, on metallic surfaces, etc., and as a filler or sealer for joints to prevent leakage of gas, water, oil, and other materials.

### G-E SOLDERS



G-E Core Solder takes the place of acid or resin core solder. It is rapid and will not spatter. G-E Soldering Paste is of the highest quality, economical, efficient and dependable. It will solder all metals except aluminum.

### G-E VARNISHES



G-E No. 1676 Black Baking Varnish is a highly effective plastic baking varnish. G-E No. 152 Clear Air-drying or Baking Varnish is used extensively on commutator rings, transformer coils, etc.

### G-E VARNISHED CLOTH



G-E Varnished Cloths are extremely flexible, have high dielectric and tensile strength, and will endure. Available in drill and duck, silk, and other materials, in black or yellow colors.

### G-E MICA



Available in segment, moulding, heater, and flexible plates. Also in tapes, composite insulations, tubing, and washers. Superior insulating properties are assured by highly exacting production methods.

# GENERAL ELECTRIC

INSULATING MATERIALS

APPLIANCE AND MERCHANDISE DEPT., GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

G-E MASTER WIRING MATERIALS AND ELECTRICAL EQUIPMENT SECTION

## G-E FLOODLIGHTS, MOTORS, HEATING EQUIPMENT

### G-E NOVALUX FLOODLIGHTING PROJECTORS

Enclosed  
Type A1-31  
Floodlighting  
Projector for  
Large Area  
Lighting



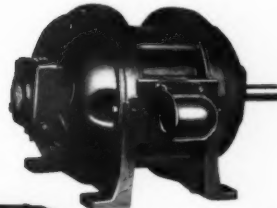
Type AL-46 ALZAK  
Floodlighting Projector for  
Inexpensive Installations

General Electric furnishes a complete line of enclosed floodlights of all wattage ratings and distribution characteristics, in both all-copper and cast-aluminum for permanent installation for floodlighting buildings, sports areas, gas tanks, railroad yards, industrial areas, etc. A complete line of all wattage ratings of inexpensive open-type floodlights in "Alzak" aluminum is also available for less permanent installations than those given above.

A complete line of all wattage ratings of portable light-weight aluminum floodlights for inexpensive floodlighting of gardens, overnight cabins, refreshment stands, construction work, etc. is also available.

A complete line of all wattage ratings of under-water floodlighting projectors for applications to swimming pools, fountains, etc. is also available. There are also available many designs of plain or ornamental standards for supporting any number of floodlights.

### G-E MOTORS AND CONTROLS



Squirrel-Cage  
Induction Motor,  
Type K



Small A-c  
Motor-starting  
Switches



When you adopt G-E motors and control as standard for your driving and controlling equipment, you are sure you have the right combination for the job, — one that will deliver precisely the performance required. Complete information is available in Motor Catalog GEA-623A and Control Catalog GEA-606-E.

### G-E "MIDGET" HEATING EQUIPMENT

General Electric small heating units solve any problem pertaining to the heating of air, liquids, or metals by localized heat. Complete information on these methods is given in Catalog GEA-1520B.

A G-E "Strip" heater for temperatures up to 1200 degrees F., in standard over-all lengths from 7 to 36 in., will take care of any localized air-heating problem, clamp-on heating, or drying operation.

Immersion heaters offer the most economical method of heating liquids in kettles, tanks, barrels, etc. The well-known G-E Calrod is assembled into headers with 1½ to 2 in. pipe threads. The terminals are protected by a steel cap. Single or three heat styles are both standard. The latter permits one quarter or full heat at the snap of a switch. Standard ratings are 600 to 10,000 watts.

For insertion in holes in platens or any process machine where efficient concentrated localized heat under 1200 degrees F. is desirable, a cartridge heating unit will do the job. Standard lengths from 2¾ to 8½ in. and diameters of ¾ to 1¼ in.

G-E gluepots are manufactured in two distinct types. The jacketless type has no water jacket and heats the glue by direct thermal contact with the walls of the pot. The water-jacketed type has an interposed heating medium, water, and is particularly adapted for quick, intermittent service. G-E cartridge units are used in both types.



"Strip"  
Heater



Immersion  
Heater



Cartridge  
Heating  
Unit



Water Jacketed  
Gluepot

# G-E TRANSFORMERS, SWITCHGEAR, INSTRUMENTS, TIME SWITCHES

## G-E TRANSFORMERS



Pyranol-filled  
Power  
Transformer

Small  
Air-  
cooled  
Transformer

**Pyranol** — General Electric's remarkable liquid insulating and cooling medium, is non-inflammable and non-explosive, and has unusually high dielectric strength. G-E transformers and capacitors filled with this new liquid make possible large savings in installation costs, as they do away with the need for expensive fire-proof vaults. Both are recognized by the National Electrical Code. Pyranol transformers are furnished up to 10,000 kva for circuits as high as 66,000 volts. Pyranol capacitors range in size from 0.5 up to 1200 kva, for 230 up to 6,900 volts, and for still higher voltages for special applications. Ask for publications GEA-2048 and GEA-77.

### SMALL AIR-COOLED TRANSFORMERS

General Electric offers a complete line of small air-cooled transformers for use on circuits of 600 volts and below. Standard sizes range from 0.05 to 50 kva. The standard voltage ratios are:

230 to 115/230	575 to 115/230	115/230 to 32
460 to 115/230	115/230 to 11.5/23	208Y to 230Y
230 volts 2-phase to 230 volts 3-phase.		

These units find a wide variety of applications for supplying power for low-voltage built-in lighting, etc. They are of small size and compact construction, and can be installed indoors in any convenient location without the use of fireproof vaults.

Complete information is given in publication GEA-897E.

## G-E INSTRUMENTS



G-E Portable  
A-c Voltmeter  
(Type AP-9)

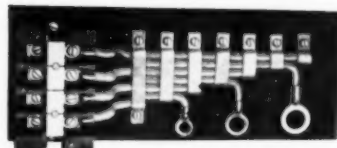
A complete line of Rectangular Switchboard Stripchart Recording, and small Portable Instruments for both alternating and direct current, is available.

For complete information refer to your nearest G-E Distributor. Ask for Catalog GEA-602-D.

The illustration shows a pocket size portable instrument, Type AS-5. Its greatest dimension is 5.5 in.; with a 2.6 in. scale, the accuracy is 1% and the net price is as low as \$22.

## G-E SWITCHGEAR SUPPLIES

A full line ranging from simple inexpensive panel wiring devices to complete panels, with instruments and circuit breakers.



Terminal board showing  
wire cleats and cup  
terminals.

Incoming line or  
feeder panel.

The General Electric Company makes a complete line of switchgear and accessories. Among these popular products are indicating lamps that reduce operating costs; control switches that appeal to users; panel fittings and switchboard wiring supplies that save time; bus supports, clamps, and connectors that reduce installation costs; disconnecting switches and power fuses that are designed for real service; oil and air circuit breakers that operate reliably and save space; complete feeder panels that are easy to install. They can be obtained quickly and easily from your local G-E Distributor.



## G-E AUTOMATIC TIME SWITCH

G.E. manufactures a complete line of Telechronmotored time switches for automatically opening and closing circuits at any pre-determined time. They are easy to install, and require no winding. They are used extensively in store and show-window lighting, street lighting, signs, billboards, apartment house hall and fire escape lighting, railroad station and yard lighting, flood-lighting buildings, monuments, fountains, construction projects, etc.; domestic water heaters and furnace control; poultry-house lighting and many other domestic, municipal and industrial applications.

They are available for 115- and 230-volt circuits, and will control up to 40 amperes on one set of contacts.



Indoor Service  
Time Switch  
Type T-27

# GENERAL ELECTRIC

G-E MASTER WIRING MATERIALS AND ELECTRICAL EQUIPMENT SECTION





**A HANDBOOK OF**

**WIRES and CABLES**

**for**

**ALL OCCUPANCIES**

**and**

**TYPES of CONDITIONS**

**All materials and recommendations in this handbook conform to the National Electrical Code. Where local regulations are in excess of the National Electrical Code, consult local inspection authorities.**



# **DEFINING THE COMPLETE SERVICE OF ANACONDA**

## **INDEX TO ANACONDA SPECIFICATIONS**

**Introduction and general description of products.**

**Tabulation of all products, with key to approved or recommended specific applications.**

**Tabulation of building wire and cable applications, with key to Anaconda products suitable for those applications.**

**Tables showing specific wire and cable requirements for major types of buildings.**

**List of all Anaconda district sales offices and manufacturing plants.**

**T**he Anaconda Wire and Cable Company offers to specification writers a complete line of wires and cables for building construction. The name *Anaconda* can be written throughout every specification with confidence that maximum quality, reasonable prices and quick delivery will be obtained.

### **ENGINEERING SERVICES**

At various district sales offices\* and at our engineering and research laboratories at Hastings-on-Hudson a staff of engineers is maintained who are qualified to give immediate assistance to specification writers having difficult or unusual problems in the design or application of wire and cable. The services of this engineering and research staff are available at all times for assistance in the solution of technical wire problems or for the development of special cables.

### **PRODUCTION AND DELIVERY SERVICE**

Strategically located manufacturing plants\* and warehouse stocks of standard products in all important centers guarantee to specification writers the prompt delivery of standard products as well as the production of special wires and cables where needed, with a minimum of delay.

### **PRODUCT CONTROL**

Research laboratories with a trained staff of engineers and chemists exercise a constant control over the production, thereby guaranteeing uniformity of product and adherence to strict standards. All research on new insulation and protective coverings is completed in the laboratories and given thorough field tests before being incorporated into standard production.

\*See last page for list of district sales offices and manufacturing plants.

# INSULATION CHARACTERISTICS



The following pages list many kinds of wire and cable, with application recommendations. Almost all of these products are made with any one of several kinds of insulation, and a word of explanation will help to make clear the reasons for these different insulations, and help the specification writer to decide which he should specify.

1. As a minimum standard, there is the National Electrical Code standard rubber insulation. This standard is acceptable in building construction where only minimum National Electrical Code requirements must be met.
2. Next higher in quality comes the Intermediate or 25% grade of rubber insulation. This insulation contains not less than 25% new rubber, and is characterized by improved life, greater resistance to abuse, and improved electrical values.
3. The 30% grade calls for insulation containing not less than 30% new rubber, and is distinctly a quality grade, characterized by long life, high electrical value, and excellent mechanical features.
4. DURACODE grade is made to special Anaconda specifications. It is a superior product, specially designed to resist deterioration from heat and oxidation. The insulation has low moisture absorption, high dielectric strength, and extremely long life. It possesses greater durability than has heretofore been available in commercial grades of building wire. Its use is recommended on all high-class construction, where it will prove to be the most economical product in the long run.

**NOTE:** All the above grades of wire are made to Safecote standards.

We can also supply wire and cable with insulation to meet many exacting requirements. A general description follows:



5. Type ACR—a high-voltage compound for lighting and power service; ozone-resistant; lasting physical and electrical properties.
6. Type ANW—a compound for low-voltage network cables and special industrial applications; highly resistant to moisture, acids and alkalis; low susceptibility to combustion and explosion.
7. Type AHR—a heat-resisting, long-aging compound for cables operating at moderate voltages in high temperature locations, such as for lighting, power, signalling and control.
8. PERFORMITE—a high grade compound for service such as fire-alarm, signal and control cables. High insulation resistance, exceptionally good aging characteristics and physical properties.
9. VARNISHED CAMBRIC CABLE—Varnished cambric cable is ideally suited for generator leads, motor leads, bus structures, industrial power and lighting, underground distribution, and other uses.
10. ASBESTOS WIRE AND CABLE—Used wherever electric wiring is exposed to excessive heat: viz., fixture wiring, boiler rooms, switchboards, special industrial heat applications.

**NOTE:** We supply wire and cable with insulation to meet:

- A. Federal Specification Board—Specification JC-101a.
- B. Federal Specification Board—Specification JC-106.



# APPLICATIONS



**RUBBER-INSULATED AND BRAID-COVERED WIRE AND CABLE. Type R—600 volts—Single conductor. Solid or stranded. Safecote.**

**Code, Intermediate, 30%, Duracode or special grades of rubber compound.**



Used for building light and power wiring in dry, protected locations. This includes wiring in conduit, underfloor duct or other raceways; knob and tube wiring; open wiring with porcelain cleats along ceilings or walls; also desirable for long, low-tension or signalling circuits.

**RUBBER-INSULATED AND BRAID-COVERED CABLE. Type RD—600 volts—Duplex conductors. Solid or stranded. Safecote.**

**Code, Intermediate, 30%, Duracode or special grades of rubber compound.**



Used for interior wiring in conduit or other metal raceways, but applications limited to circuits using wire sizes No. 14 to No. 6. Also used for streamers for temporary light and power on construction jobs.

**RUBBER-COVERED FIXTURE WIRE. Type RF—300 volts—Single conductor. Solid or stranded. Safecote.**

**Code, Intermediate, 30%, Duracode or special grades of rubber compound.**



Used on fixtures, where operating temperature is not excessive.

**RUBBER-INSULATED, LEAD-COVERED WIRE AND CABLE. Type RL—600 volts—Single, duplex or three conductor. Solid or stranded.**

**Code, Intermediate, 30%, Duracode or special grades of rubber compound.**



For use in moist locations where installed in raceway or otherwise protected from mechanical damage. Particularly useful for wiring in laundries, dye housing, dairies, creameries and in locations liable to be flooded. Also used for underground runs in conduit or other raceway to outlying buildings, yard lights, gasoline pumps, etc.

**FLEXIBLE CORD. Type FF—Single conductor.**

**Code, Intermediate, 30% or special grades of rubber compound.**



For use on chain-drop fixtures, in dry locations.

**REINFORCED CORD. Type P—Two conductor. Code grade.**



For use on portable tools, drop-cord fixtures, etc., where subject to hard usage. Suited for dry locations only.

**REINFORCED CORD. Type PWP—Two conductor. Code grade.**



For use on pendants where not subject to hard usage. May be used in damp places.

**BRAID OVERALL. Type PD—Two conductor. Code grade.**



For use on portable lamps, clocks, or for drop-lights, will not stand hard usage, or moisture.

**HEAVY-DUTY CORDS. Type K—Two conductor and three conductor. Code grade.**



For use on portable tools, lamps, pendants, and general stage use—Border Light Cable. Particularly designed to withstand hard usage and dampness.

**ALL-RUBBER CORDS. Type S or SJ—Two or three conductor. 30% insulation, 40% jacket.**



For use on all portable electric machines, cord fixtures, etc., where subject to hard usage and dampness.

**ALL-RUBBER CORD. Type PO-SJ—Two conductors-parallel. Furnished in Black, Green, Brown and Ivory-colored Rubber Jacket.**



Smooth-finish rubber cord for use on portable lamps, radios, clocks, etc., where not subject to hard use.

# APPLICATIONS

**SECURITY FLEX CORDS.** Single, two, three and four conductor; heavy duty or light-duty. 60% Mold-cured.



Particularly recommended for use on portable tools, lamps, etc., in garages, industrial plants and other locations where severe service and moisture are encountered.

**FLEXIBLE HEAT RESISTING.** Type CF—Cotton braid. Single conductor Fixture Wire.



For use on fixtures in dry places, operating at not over 300 volts.

**SINGLE CONDUCTOR.** Type AF—Asbestos insulation, with or without cotton or rayon braid.



For use on fixtures in dry places, operating at high temperature and at not over 300 volts.

**Type CFPD—Two or three conductors.** Twisted, braid overall.



For pendants not subject to hard usage.

**ANNUNCIATOR WIRE—Series 9260.** Single conductor, or twisted pair wire. Cotton covering, saturated with paraffin.



For low-tension circuits, usually run unprotected in walls and ceilings. Not adapted for pulling into conduit or other raceways. Not serviceable in damp locations.

**DAMP-PROOF OFFICE WIRES—Series 9270.** Single conductor or duplex.



Similar use, but more satisfactory when exposed to dampness.

**ANTENNA WIRE—Series 1510.** Solid or flexible, bare, tinned or enameled.



Used for radio receiving or transmitting antennas.

**RUBBER-INSULATED TELEPHONE WIRE.** Outside Twisted — Series 7562. Distributing Drop wire twisted conductors.



Particularly adapted for overhead telephone or other signalling runs between buildings.

**INSIDE WIRE—Series 7560.** Twisted conductors. Both series 7562 and 7560 are furnished with rubber insulation on each conductor and can be obtained in one or more pairs with weather-proofed braid or lead sheath.



A most satisfactory wire for interior telephone systems, code calling systems, annunciator or bell systems.

**ARMORED CABLES.** Type AC—600 volts. Single, two, three and four conductors — solid or stranded.



For general light and power wiring in non-fireproof homes, industrial plants and other buildings. May be run either concealed or exposed, in dry locations. Very useful for fishing work on remodelling jobs.

**Type ACL—600 volts. Two and three conductors.**



For use same as above, except that this cable resists moisture. It may therefore be used for connections to outdoor signs, runs up poles to floodlights and in any damp indoor location.

**ARMORED LAMP CORD.** Type CA—Two conductors. Code grade.



For pendants in dry places where subject to hard usage, and in some hazardous locations. Also, for pendants in show windows.

**ARMORED GROUND WIRE—Series 6040.** No. 8 or No. 6 AWG, single conductor, solid.



Used for grounding interior wiring systems, where armor is required to protect the copper conductor from mechanical injury.

**FLEXIBLE STEEL CONDUIT—Series 6090.** Inside diameter from 5/16" to 3".



May be used in place of rigid conduit. If used in damp locations, wires must be lead-sheathed. Very useful for short conduit runs in cramped locations, where bends must be sharp or irregular, and for short connections between motors and control devices.

# APPLICATIONS



**DURAX NON-METALLIC SHEATHED CABLE—600 volts.** Made with or without ground wire, in two or three conductors, sizes No. 14 to No. 4.



Widely used for interior concealed or exposed jobs, where moisture is not present and where there is no danger of mechanical injury. This cable may be fished. Particularly adapted to residential jobs.

**DURADUCT FLEXIBLE NON-METALLIC CONDUIT.** Inside diameter from 7/32" to 2 1/2".



Used for the protection of open wires in knob-and-tube or cleat work. Also used to protect wires which must be fished in a partition or ceiling.

**DURACORD WIRE AND CABLE.** Made in single, two, three and four conductors, in all sizes.



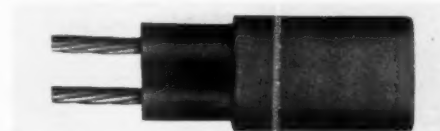
For heavy-duty portable cord service where extremely hard service is encountered, as in industrial plants, mines, etc. The "last word" in portable cords. Specify it for: connections to dental and medical equipment, tools, machines, stage applications, etc.

**WEATHERPROOF WIRE AND CABLE. URC Type.**



For use outdoors—not in conduit—or for open wiring in buildings where corrosive vapors exist.

**VARNISHED CAMBRIC CABLE.** Made in single, two, three and four conductors in all sizes. Furnished with weatherproofed or flameproofed braid or lead sheath.



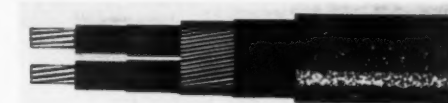
For power wiring inside buildings; high-tension primary lines or low-voltage distribution. For damp locations use lead-sheathed cable only.

**NON-METALLIC SHEATHED CABLE. Type T Dura-seal.** Made in any number of conductors and in all sizes. 30% or special grades of rubber compound.



For direct burial underground. No conduit is needed, as the cables are armored for protection against mechanical injury, and sheathed for protection against water. For power lighting or control circuits, and especially recommended for underground service entrance cable.

**SERVICE DROP CABLES. Types C, CF, CFF.** Two and three conductors, No. 12 to No. 2 with 30% rubber compound. For services up to 150 volts to ground.



For service run from pole line to house. May also be run all the way to meter if in conduit from weatherhead to meter (in some localities the conduit is not required). This cable withstands severe weather, and retains its good appearance. The outer braid will not festoon.

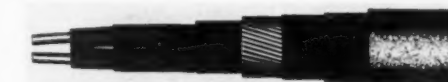
**SERVICE ENTRANCE CABLE. Types SC, SCF, SCFF, SCA, SCAF.** Two and three conductors with 30% rubber compound. For services up to 150 volts to ground.



For service runs from pole to house, down to meter. The cable may also be run direct to an electric range inside the house. No conduit is necessary.

**TYPE ASEC—Armored Service Entrance Cable** for unprotected locations. For services up to 150 volts to ground.

**UNDERGROUND SERVICE ENTRANCE CABLE. Types T and D Dura-seal.** Single and multiple conductors in all sizes. For services up to 600 volts to ground.



For service runs from pole, or from transformers vault, underground to house, and into house to meter. Type T is intended to be buried for its entire length. Type D may be run up pole to overhead lines.

**SIGNAL AND CONTROL CABLE.** Multi-conductors sizes No. 19 to No. 8 AWG. Solid or stranded. 30%, Duracode or special grades of rubber compound. Weatherproof braided, rubber-jacketed or lead-sheathed.



For use in any type of signal or control circuits within or between buildings, in elevators, etc.

**NEON SIGN AND OIL BURNER IGNITION CABLE.** Single conductor.



For use with Neon signs and connections for oil burner ignition systems.

**SLOW BURNING WIRE AND CABLE. Type SB—**Single conductor.



For use in switchboards, in wire towers, in hot locations generally. May be installed in conduit if location is permanently dry.

## TO MEET THIS CONDITION

## USE THIS ANACONDA PRODUCT

### 1. SERVICE ENTRANCE.

A. Overhead.

B. Underground.

### 2. RUNS TO OUTLYING BUILDINGS, GARAGE, GROUND LIGHTING.

A. Overhead.

B. Underground.

### 3. OPEN WIRING IN RESIDENCES, IN- DUSTRIALS, ETC.

A. Dry locations.

B. Damp locations.

C. Corrosive locations.

D. Hazardous locations.

E. Hot locations.

### 4. CONCEALED KNOB-AND-TUBE WORK.

A. Dry locations.

B. Damp locations.

C. Corrosive locations.

A. 1. Cheapest job: Weatherproof wire, URC Type.

A. 2. Good job: Type C, CF or CFF Service Drop cables, with conduit protection down wall of house to meter.

A. 3. Best job: Type SC, SCF, SCFF, SCA or SCAF Service entrance cable, without conduit protection. May be run all the way to electric range.

B. 1. For residences or other small buildings, Type T if cable is buried for its entire length. Use Type D Duraseal if buried cable must be extended up pole to overhead lines.

B. 2. For commercial or industrial buildings, etc., use Type RL or varnished VC lead-sheathed cable, in conduit or underground duct.

A. 1. Cheapest job: Weatherproof wire, URC Type.

A. 2. Good job: Type C, CF or CFF Service Drop cables, with conduit protection down wall of house to meter.

B. 1. For residences or other small buildings, Type T if cable is buried for its entire length. Use Type D Duraseal if buried cable must be extended up pole to overhead lines.

A. 1. Type R single conductors, solid or stranded. Code, intermediate, 30%, Duracode or special grades. Where liable to mechanical injury, must be protected by running in boards or conduit. In latter case, specify Anaconda Flexible Steel Conduit, or Duraduct Flexible Non-Metallic Conduit.

B. 1. Lead-sheathed wire or cable.

B. 2. Rubber-jacketed wire or cable.

C. 1. Weatherproof or rubber-jacketed wire or cable, as directed by local authorities.

D. 1. Open wiring not permitted.

E. 1. Type R with special rubber compound.

E. 2. Asbestos wire and cable AVC.

A. 1. Type R single conductors, solid or stranded. Code, intermediate, 30%, Duracode or special grades. Where liable to mechanical injury, must be protected by running in boards or conduit. In latter case, specify Anaconda Flexible Steel Conduit, or Duraduct Flexible Non-Metallic Conduit.

B. 1. Rubber-jacketed wire or cable.

C. 1. Rubber-jacketed wire or cable.





# CONDITIONS

## TO MEET THIS CONDITION

- D. Hazardous locations.
- E. Hot locations.
- 5. CONDUIT WORK.**
  - A. Dry locations.
  - B. Wet or damp locations.
  - C. Corrosive locations.
  - D. Hazardous locations.
  - E. Hot, dry locations.
- 6. SURFACE METAL RACEWAY SYSTEMS.**
  - A. Dry locations.
- 7. ARMORED CABLE WORK.**
  - A. Dry locations.
  - B. Wet locations.
  - C. Hot, wet or corrosive locations.
- 8. UNDERFLOOR RACEWAYS.**
  - A. Open-bottom types.
  - B. Fully enclosed types.
  - C. Wet locations.
- 9. NON-METALLIC SHEATHED CABLE SYSTEMS.**
  - A. Dry locations.
  - B. Wet, hot, hazardous or corrosive locations.
- 10. ELECTRICAL METALLIC TUBING WORK.**
  - A. Dry, wet, hot, corrosive locations.

## USE THIS ANACONDA PRODUCT

- D. 1. *Open wiring not permitted.*
- E. 1. Type R with special rubber compound.
- E. 2. Asbestos wire and cable.
- A. 1. Type R single conductors, or Type RD duplex conductors.
- B. 1. Type R conductors may be used if conduit system is made water-tight. Otherwise, lead-sheathed wires and cables shall be used.
- C. 1. Type R conductors may be used, but conduit should be corrosion-resisting, and system should be vapor-tight.
- D. 1. Type R conductors may be used, but conduit system must be installed with suitable protective equipment.
- E. 1. In boiler rooms, bakeries, steel mills, steam tunnels, etc., wires in conduit should be Type R with special rubber compound, asbestos wire and cable.
- A. 1. Type R conductors, not larger than No. 8.
- A. 1. Type AC. May be run either exposed or concealed, and may be fished. May be buried in plaster.
- B. 1. Type ACL. For underground runs, imbedded in masonry concrete or fill in buildings under construction, or if exposed to moisture or vapors which have a deteriorating effect on rubber insulation.
- C. 1. Not to be used.
- A. 1. Type RD, or Type R with double braid. If open-bottom pads are imperfect, Type AC armored cable or Durax non-metallic sheathed cable must be used. Conductors not larger than No. 8.
- B. 1. Type R or Type RD.
- C. 1. Underfloor raceway systems should be designed to exclude moisture. In case of doubt, Type RL wire or Type ACL cable should be used.
- A. 1. Durax non-metallic sheathed cable may be run either exposed or concealed, and may be fished.
- B. 1. This cable cannot be used in these locations.
- A. 1. Follow same rules as given in Section 5 on conduit work. Conductors larger than No. 0 shall not be used.



## TO MEET THIS CONDITION

## USE THIS ANACONDA PRODUCT

### 11. CAST-IN-PLACE RACEWAY WORK.

- A. Dry locations.
- B. Wet locations.
- C. Hot, dry locations.

### 12. UNDER-PLASTER EXTENSIONS.

- A. Conduit, flexible conduit, armored cable.

### 13. WIREWAYS.

- A. For distribution to motors, lighting, etc.

### 14. FIXTURE APPLIANCE AND PORTABLE TOOL WIRING.

- A. Dry locations.
- B. Hot, dry locations, or where fixtures will be heated by lamps.
- C. Damp locations.

- A. 1. Type R or Type RD wires or cables.
- B. 1. Type RL wire or Type ACL cable should be used.
- C. 1. Type R or Type RD with special rubber compound.

A. 1. If runs are in conduit, follow rules under section 5 for "conduit work". If flexible conduit is used, specify "Anaconda" Series 6090, and follow wire rules under "conduit work". If armored cable is used, follow rules under Section 7 for "armored cable".

A. 1. Use Type R wires or cables. Not more than 30 conductors allowed in one wireway, except where all in excess of 30 are for signalling circuits or are control wires between a motor and its starter. No conductor larger than 500,000 c.m. shall be used.

A. 1. On chain-drop fixtures use Type FF single conductor.

A. 2. On portable lamps, clocks, etc., use Type C-twisted pair lamp cord or type PO-parallel lamp cord.

A. 3. On portable tools, for drop-cord fixtures, where subject to hard usage, use Type P two conductor reinforced cord.

A. 4. For drop-cord fixtures, portable lamps where not subject to hard usage, use Type PD two conductor cord with overall braid.

A. 5. For portable tools, lamps, pendants, and for portable stage applications use Type K heavy-duty cords, two conductor or multi-conductor. Or—use DURACORD, SECURITYFLEX or Type S or SJ all-rubber cords for severe service where long life is essential.

A. 6. For radios, portable lamps, where appearance is a factor, use Type PO-SJ all-rubber cord.

B. 1. Use Type CF cotton braid cord or Type AF asbestos-insulated cord, on chain fixtures or pipe-stem fixtures.

B. 2. Use Type CFPD twisted, braided cord for pendants.

C. 1. Use Type PWP reinforced cord for pendants not subject to hard usage.

C. 2. For portable tools, lamps, pendants, and for portable stage applications, use Type K heavy-duty cord, or for long life under most severe service, use

# CONDITIONS

## TO MEET THIS CONDITION

- D. Corrosive locations (where cord will be exposed to vapors, gasoline, oil, etc.)
- E. Hazardous locations.

### 15. LOW-TENSION SIGNALLING CIRCUITS.

- A. In residences, low-cost apartments and small stores.
- B. In fine residences, apartments, office buildings, industrial plants, institutions, etc.

## USE THIS ANACONDA PRODUCT

either DURACORD, SECURITYFLEX or Type S or SJ all-rubber cord.

Brewery cord and deck cable are also designed for these applications.

D. 1. Always use DURACORD for portable tools, pendants, etc.

E. 1. For fixture wiring in Class I, II, III locations, use Type R, 3/64" insulation wire, in conduit hangers.

E. 2. For portable lamps or tools, use DURACORD or Type S cord, with extra ground conductor in Class I, II, III, IV locations.

E. 3. For fixture wiring in Class IV locations, use Type R wire, enclosed in conduit, size not less than No. 14.

E. 4. In garages: For portable lamps and tools charging cables, etc., use DURACORD, SECURITYFLEX, or Type S cords.

E. 5. In motion-picture studios and projection rooms, for portable lamps, tools, etc., use DURACORD, SECURITYFLEX, Type S, Type K or stage cable. For pendant lamps, use Type P reinforced or Type CA armored cord.

E. 6. In theatres: Border cables should be DURACORD, Type K or Type S cords. Pendants in dressing rooms must be wired with Type P reinforced cord, Type AC armored cable or Type CA armored cord. For general stage portable use, specify DURACORD, Type K or Type S cords.

A. 1. For least expensive job, use annunciator or damp-proof office wire. Series 9260 or 9270.

A. 2. For a "better job," use rubber-insulated telephone wire, Series 7560.

A. 3. For the "best job," use Type R wire in conduit, Type AC armored cable, or Durax non-metallic sheathed cable.

A. 4. For long runs, use Type R wire or Type AC armored cable.

A. 5. For outdoor runs, use outside twisted distributing drop rubber-insulated telephone wire, Series 7562.

B. 1. Use Type R wires in conduit, or in underfloor raceways.

B. 2. Use Type AC armored cable in non-fireproof construction where costs must be kept to a minimum.

B. 3. For underground runs, use Type RL rubber-insulated, lead-covered wire or parkway cable.



## APARTMENTS

UTILITY	REQUIREMENTS	KIND OF WIRE OR CABLE	ANACONDA TYPE, TRADE NAME OR SERIES NO.	MADE IN SIZES
Service Entrance.	a. Overhead 2 or 3 wire service; weather-resistant.	Service drop cables.	C, CF, CFF.	#12 to #2 two or three conductor.
		Service entrance cables.	SC, SCF, SCFF, SCA, SCAF.	#12 to #2 two or three conductor.
		Armored service entrance cables.	ASEC.	#12 to #2 three conductor.
	b. 2 or 3 wire service for burial directly in ground.	Underground service entrance cable.	Type T Duraseal if buried for entire length.	All sizes.
			Type D Duraseal if part of cable will be run up pole.	All sizes.
	c. 2, 3 or 4 wire service for installation in conduit or duct underground.	Rubber-insulated, lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.
Interior Lighting Mains and Building Power. (Elevators, etc.)	a. Inexpensive wiring; in non-fireproof buildings; where metal protection is desired.	Armored cable.	AC in dry locations.	#14 to #2 in single to four conductor.
		Armored leaded cable.	ACL in wet locations, or if buried in masonry.	#14 to #4 in two or three conductor.
	b. Ditto, where metal protective covering is not required.	Non-metallic sheathed cable.	Durax.	#14 to #4 two and three conductor, with ground conductor.
	c. For rigid conduit wiring in fireproof buildings.	Rubber-insulated building wire or cable.	R—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M.
Branch Circuits—Light and Power.	a. Inexpensive wiring in non-fireproof buildings; where metal protection is desired.	Armored cable.	AC—in dry locations.	#14 to #2 in single to four conductor.
		Armored leaded cable.	ACL—in wet locations or if buried in masonry.	#14 to #4 in two or three conductor.
	b. Ditto, where metal protective covering is not required.	Non-metallic sheathed cable.	Durax.	#14 to #4 two and three conductor, with ground conductor.
	c. For rigid conduit wiring in fireproof buildings.	Rubber-insulated building wire or cable.	R—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M.
	d. For wiring in hot locations—in conduit.	Slow-burning wire. Asbestos.	SB, AVC.	#14 to 2,000,000 C.M.
Outdoor Runs to Garages, Driveway Lights, etc.	a. For wiring buried directly in ground.	Duraseal cable.	Type T DURASEAL.	All sizes.
	b. For wiring in conduit or duct.	Rubber-insulated, lead-covered cable.	RL.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.
Interior Telephones, Door Opener, Bells or other low-voltage signalling Systems.	a. Low-cost wiring; dry locations only; concealed.	Annunciator wire.	"Annunciator wire." Series 9260.	#14 to #24, single conductor.
	b. Ditto—but damp-resistant.	Damp-proof office wire.	"Damp-proof office wire." Series 9270.	#14 to #20, single or duplex.
	c. Long-life service, in conduit or unprotected; also for exposed wiring.	Rubber-insulated telephone wires.	"Rubber-insulated telephone wires." Series 7560 or 7562.	#14 to #22, twisted pair.
	d. Maximum protected wiring, in conduit.	Rubber-insulated building wire.	R.	#14 or larger, as needed.
Antenna System.	a. For antenna.	Antenna wire.	"Antenna Wirs." Series 1510.	#12 to #15, bare-tinned or enameled.
	b. For lead-in, preferably in conduit.	Rubber-insulated building wire.	R.	#14 or larger, as needed.



# OCCUPANCIES

## RESIDENCES

UTILITY	REQUIREMENTS	KIND OF WIRE OR CABLE	ANACONDA TYPE, TRADE NAME OR SERIES NO.	MADE IN SIZES
Service Entrance.	a. Overhead 2 or 3 wire service; weather-resistant; mechanically strong.	Service drop cables.	C, CF, CFF.	#12 to #2 two or three conductor.
		Service entrance cables.	SC, SCF, SCFF, SCA, SCAF.	#12 to #2 two or three conductor.
		Armored service entrance cables.	ASEC.	#12 to #2 three conductor.
	b. 2 or 3 wire service for burial directly in ground.	Underground service entrance cable.	Type T Duraseal if buried for entire length.	All sizes.
			Type D Duraseal if part of cable will be run up pole.	All sizes.
	c. 2, 3 or 4 wire service installed in conduit or duct underground.	Rubber-insulated lead-covered cable.	RL.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 duplex. #14 to 500,000 C.M. three conductor.
Interior Lighting Mains and Power Mains.	a. Inexpensive wiring, "Knob and tube," in non-fireproof buildings.	Rubber-insulated building wire or cable.	R.	#14 to 2,000,000 C.M. single conductor.
	b. Ditto, where metal protection is desired.	Armored cable.	AC—for dry locations.	#14 to #2 in single to four conductor.
		Armored leaded cable.	ACL—in wet locations, or if buried in masonry.	#14 to #4 in two or three conductor.
	c. Ditto, where metal-protected covering is not required.	Non-metallic sheathed cable.	Durax.	#14 to #4 two and three conductor, with ground conductor.
	d. For wiring fully protected in conduit.	Rubber-insulated building wire or cable.	R.	#14 to 2,000,000 C.M.
			RD.	#14 to #6 two conductor.
Branch Circuits, Light and Power.	a. Inexpensive wiring, "Knob and tube," in non-fireproof buildings.	Rubber-insulated building wire or cable.	R.	#14 to 2,000,000 C.M. single conductor.
	b. Ditto, where metal protection is desired.	Armored cable.	AC—for dry locations.	#14 to #2 in single to four conductor.
		Armored leaded cable.	ACL—in wet locations, or if buried in masonry.	#14 to #4 in two or three conductor.
	c. Ditto, where metal protection is not desired, and the "Knob and tube" system is not desired.	Non-metallic sheathed cable.	Durax.	#14 to #4 two and three conductor, with ground conductor.
	d. For wiring fully protected in conduit.	Rubber-insulated building wire or cable.	R.	#14 to 2,000,000 C.M.
			RD.	#14 to #6 two conductor.
Outdoor Runs to Garages, Driveway Lights, etc.	a. Inexpensive overhead wiring—with conduit protection up sides of buildings.	Rubber-insulated building wire or cable.	R.	#14 to 2,000,000 C.M. single conductor.
	b. Ditto—for overhead span only, not inside of conduit.	Weatherproof wire or cable.	URC.	All sizes.
	c. For wiring buried directly in ground.	Duraseal cable.	Type T Duraseal.	All sizes.
	d. For wiring in conduit or duct.	Rubber-insulated, lead-covered cable.	RL.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 duplex. #14 to 500,000 C.M. three conductor.

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## RESIDENCES

UTILITY	REQUIREMENTS	KIND OF WIRE OR CABLE	ANACONDA TYPE, TRADE NAME OR SERIES NO.	MADE IN SIZES
Interior Telephones, Bell wiring and other low-voltage Signalling Systems.	a. Low-cost wiring; dry locations only; concealed.	Annunciator wire.	"Annunciator wire." Series No. 9260.	#14 to #24 single conductor.
	b. Ditto—but damp-resistant.	Damp-proof office wire.	"Damp-proof office wire." Series No. 9270.	#14 to #20, single or duplex conductor.
	c. Long-life service, in conduit or unprotected; also, for exposed wiring.	Rubber-insulated telephone wires.	"Rubber-insulated telephone wires." Series No. 7560 and 7562.	#14 to #22 twisted pair.
	d. Long-life service, non-metallic.	Non-metallic sheathed cable.	Durax.	#14 or larger, as needed; two and three conductor.
	e. Maximum protected wiring, in conduit.	Rubber-insulated building wire.	R.	#14 or larger, as needed.
Antenna System.	a. For outside antenna.	Antenna wire.	"Antenna wire." Series No. 1510.	#12 to #15, bare, tinned or enamelled.
	b. For lead-in, preferably in conduit.	Rubber-insulated building wire.	R.	#14 or larger, as needed.

## BANKS

UTILITY	REQUIREMENTS	KIND OF WIRE OR CABLE	ANACONDA TYPE, TRADE NAME OR SERIES NO.	MADE IN SIZES
Service Entrance.	2, 3 or 4 wire underground, in conduit or duct.	Rubber-insulated lead-covered cable, or varnished cambric, lead-covered.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 dualex. #14 to 500,000 C.M. three conductor.
Interior Lighting Mains and Building Power Feeders.	a. Wiring fully protected in conduit.	Rubber-insulated building wire or cable.	R—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M.
	b. Ditto—hot locations.	Slow-burning wire. Asbestos.	SB, AVC.	#14 to 2,000,000 C.M.
	c. Ditto—wet locations.	Rubber-insulated lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 dualex. #14 to 500,000 C.M. three conductor.
Branch Circuits—Light and Power.	a. Wiring in conduit, normal conditions.	Rubber-insulated building wire.	R—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M.
	b. Ditto—hot locations.	Slow-burning wire. Asbestos.	SB, AVC.	#14 to 2,000,000 C.M.
	c. Ditto—wet locations.	Rubber-insulated lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 or larger, as needed; one to three conductor.
	d. Vault lighting—in conduit.	Rubber-insulated lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 or larger, as needed; one to three conductor.
Feed for Vault; Hold-up Alarm and Vault Alarm.	Wiring must be foolproof, and installed in conduit.	Rubber-insulated lead-covered wire or cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 or larger, as needed; one to three conductor.
Interior Telephones; Bell or Annunciator Systems and other low-voltage Signalling Systems, Watchman's Patrol System.	Wiring in conduit, with minimum break-down risk.	Rubber-insulated building wire.	R.	#14 or larger, as needed.
Outside Lights and Signs.	Water-tight wiring in conduit.	Rubber-insulated lead-covered wire.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 or larger, as needed; one to three conductor.

# OCCUPANCIES

## HOSPITALS

UTILITY	REQUIREMENTS	KIND OF WIRE OR CABLE	ANACONDA TYPE, TRADE NAME OR SERIES NO.	MADE IN SIZES
Service Entrance.	a. 2, 3 or 4 wire underground, in conduit or duct.	Rubber-insulated lead-covered cable, or varnished cambric, lead-covered.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.
Interior Lighting Mains and Building Power Feeders.	a. Wiring fully protected in conduit.	Rubber-insulated building wire or cable.	R.	#14 to 2,000,000 C.M.
	b. Ditto—hot locations.	Slow-burning wire. Asbestos.	SB, AVC.	#14 to 2,000,000.
	c. Ditto—wet locations.	Rubber-insulated lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.
Branch Circuits—Light and Power.	a. Wiring in conduit, normal conditions.	Rubber-insulated building wire.	R—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M.
	b. Ditto—hot locations.	Slow-burning wire. Asbestos.	SB, AVC.	#14 to 2,000,000.
	c. Ditto—wet locations.	Rubber-insulated lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 or larger, as needed; one to three conductor.
Bell or Annunciator Systems; Interior Telephones.	a. Wiring in conduit.	Rubber-insulated building wire.	R.	#14 or larger as needed.
		Multiple conductor cable.	Series 7560.	Any number of conductors. Sizes #19 AWG and larger.
Nurses Call System; Fire Alarms System.	a. Wiring in conduit.	Rubber-insulated building wire.	R.	#14 or larger as needed.
Outside Lights and Signs.	a. Water-tight wiring in conduit.	Rubber-insulated lead-covered wire.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 or larger as needed; one to three conductor.

## MONUMENTAL STRUCTURES—CATHEDRALS, AUDITORIUMS, MEMORIALS

UTILITY	REQUIREMENTS	KIND OF WIRE OR CABLE	ANACONDA TYPE, TRADE NAME OR SERIES NO.	MADE IN SIZES
Service Entrance.	a. 2, 3 or 4 wire underground, in conduit or duct.	Rubber-insulated lead-covered cable, or varnished cambric, lead-covered.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.
Interior Light and Power Mains.	a. For circuits which will operate for many decades, in conduit.	Rubber-insulated lead-covered wire or cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.
Branch Circuits—Light and Power.		Varnished cambric, lead-covered cable.	Varnished Cambric Cable.	Any number of conductors and in all sizes.
Interior Telephones, and other low-voltage Signalling Systems.		Note: Lead-covered cable should be thoroughly greased before pulling in, to permit easy removal after many years in conduit.		
Loud Speaker Systems.	b. For circuits, wiring of which will be replaced in a relatively few years. In conduit.	Rubber-insulated building wire or cable.	R—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor
Outdoor Runs to Driveway Lights, etc.	a. For wiring buried directly in ground.	Type T Duraseal cable.	Type T Duraseal.	Any number of conductors and all sizes.
	b. For wiring in conduit or duct.	Rubber-insulated lead-covered cable.	RL—Better than Code Grade desirable. See section regarding insulation characteristics.	#14 to 2,000,000 C.M. single conductor. #14 to #4 0 Duplex. #14 to 500,000 C.M. three conductor.

# **ANACONDA**

## **WIRE & CABLE COMPANY**



**General Sales Offices . . . 25 Broadway, New York**

**Chicago Sales Office . . . 20 North Wacker Drive**

### **DISTRICT SALES OFFICES:**

**ATLANTA, Georgia**

408 Ten Forsyth Street Bldg.

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**CLEVELAND, Ohio**

1504 Builders Exchange Bldg.

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**DENVER, Colorado**

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430 Colyton Street

**MILWAUKEE, Wisconsin**

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2615 Park Avenue

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1415 Carondelet Bldg.

**PHILADELPHIA, Pennsylvania**

808 Architects Bldg.—17th and Sansom Sts.

**PITTSBURGH, Pennsylvania**

1722 Oliver Bldg.

**ROCHESTER, New York**

216 Rockingham Street

**ST. LOUIS, Missouri**

Midwest Terminal Bldg.—710 North 12th Blvd.

**SAN FRANCISCO, California**

360 Ninth Street

**SEATTLE, Washington**

914-920 First Avenue, So.

**WASHINGTON, D. C.**

911 Investment Bldg.

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**Ansonia, Conn.**

**Great Falls, Mont.**

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**Marion, Ind.**

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**Oakland, Cal.**

**Orange, Cal.**

**Pawtucket, R. I.**

**Sycamore, Ill.**







CONTRACTORS

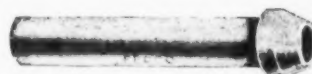
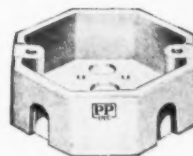
ARCHITECTS

# Specify PORCELAIN PRODUCTS

FOR YOUR BEST WORK—  
FOR MOST PROFIT TO YOU



These new all porcelain outlet and switch boxes have been brought out to meet a constantly growing demand for complete elimination of grounding dangers and a greater factor of safety in house wiring. Both the outlet and switch box conform to existing standards in every detail and dimension. Tapped metal inserts are provided for mounting switch mechanism, receptable or face plate. The right number of knockout holes is provided in the proper places. All boxes are made of the highest grade of electrical porcelain and will be furnished glazed or unglazed as specified.



## QUALITY AT A PRICE

Alligator assembled knobs have been famous for years for their remarkable holding power and sturdy construction. They lead the field in quality and sales. The body is Hi-fired first quality electrical porcelain assembled with a washer locked steel nail and leather head ring to prevent breakage when driven in. The one, two and three wire cleats and porcelain tubes furnished in conjunction with these Alligator knobs are of the same high grade material and will deliver years of dependable service.



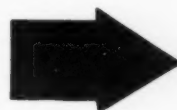
## MEN WHO KNOW SPEAK FOR KNOB AND TUBE WIRING

Contractor—"More profit to me—and my customer gets a better job. In barns or wherever there is any chance of corrosion I always use your knobs and tubes."

Wholesaler—"Additional space between the wires. No possibility of driving nails through armor. No trouble from dampness or fumes. Porcelain is impervious."

Contractor—"Safer as to fire hazard and life hazard. Government inspectors tell me to use it in preference to any other type of wiring so that I can be sure of having no shorts or grounds."

FOR PROPER INSTALLATION OF THESE  
PRODUCTS SEE THE FOLLOWING PAGES



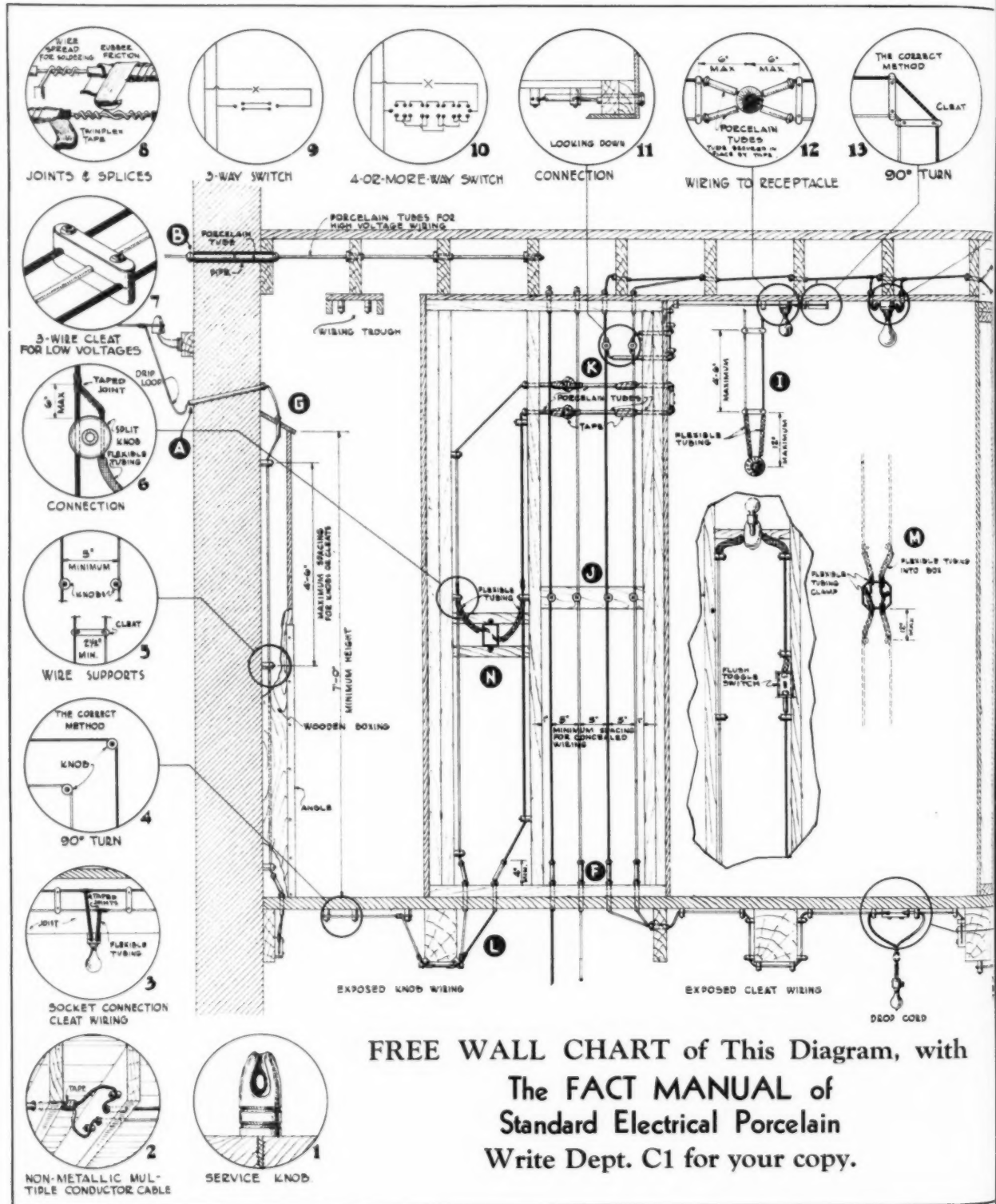
# PORCELAIN PRODUCTS, INC.

PARKERSBURG,

WEST VIRGINIA, U. S. A.

# Concealed Knob and Tube Wiring . . .

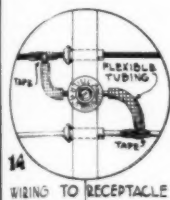
Specify One of These Types of Wiring on



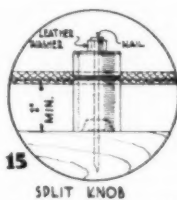


# Open Cleat Wiring

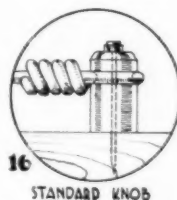
## Your Next Job



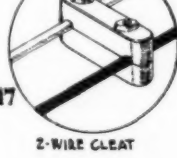
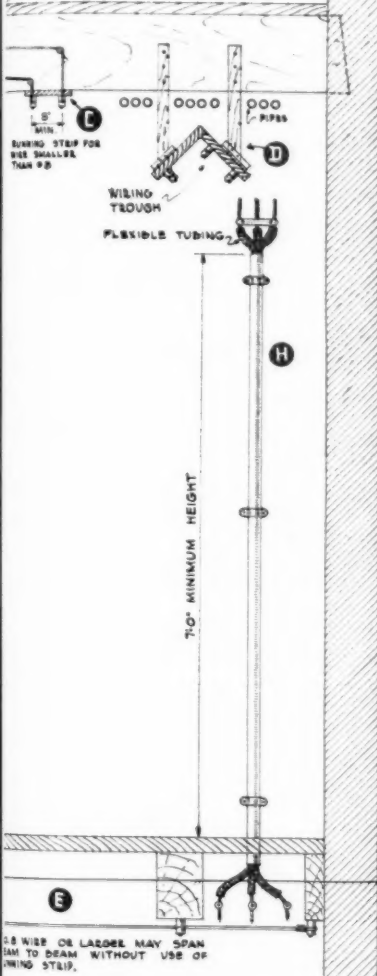
14 WIRING TO RECEPTACLE



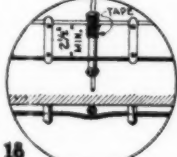
15 SPLIT KNOB



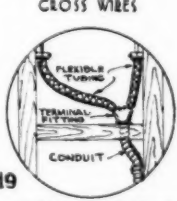
16 STANDARD KNOB



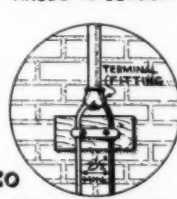
17 2-WIRE CLEAT



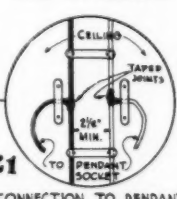
18 CROSS WIRES



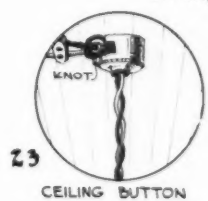
19 KNOBS TO CONDUIT



20 PIPE TO CLEATS



21 CONNECTION TO PENDANT SOCKET FROM CLEAT SUPPORT



23 CEILING BUTTON



22 SPLIT TUBE

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(Circles 3-5-7-13-17-21). Show the proper use of both two and three wire cleats. However, the latter are not recommended except for running a switch loop in connection with a two-wire circuit or for low voltages.

(Circles 3-6-14-21-23). Whenever a tap is made on a conductor, always protect the connection against mechanical strain.

For a switch or receptacle outlet, see circle 6.

For a lamp receptacle on open wiring run on side of joist, see circle 3.

For a lamp socket on ceiling with tap to concealed wiring, see circle 14.

For a tap to open cleat wiring for a pendant, see circle 21.

For a tap to open wiring using a ceiling button, see circle 23. Where outlet boxes are used, strain is always taken care of by the box cover, particularly in the case of pendants, which should have a knot tied inside the box.

(Circles 4-6-15). When using split knobs and two wires, parallel wires must be placed in outside groove of knobs.

(Circle 8). All joints in conductors must be both mechanically and electrically secure without solder. They must then be soldered with the solder well sweated into the wraps of the conductors, then the joints must be covered with insulation equal to that on the wire.

Proper tapering is accomplished by wrapping first with rubber and then friction tape, or with a combination rubber and friction tape. In lieu of soldering and taping, approved wire connectors made of an insulating material may be used.

(Circles 9 and 10). 3-way switch connections. 4-way switch connections.

(Circle 12). In installing lamp sockets on open wiring the wires should run directly into the fitting, eliminating entirely any bare metal contacts outside the device, and exposed to accidental contact.

For this same reason all broken or defective fittings should always be replaced immediately.

(Circle 20). Where change is made from either concealed knob and tube or open cleat wiring to either conduit or armored cable, approved terminal devices must be used on ends of cable or conduit providing separately bushed insulated openings for each conductor.

(Circle 22). In the event that tubes either through timbers or used at cross-overs become broken, split tubes as shown may be used at a considerable saving.

(A). In entering a building through a wall a drip loop should be provided on each wire to permit accumulated moisture to drop or run off instead of following the wire into the building, or where the wall is hollow, into the hollow wall space. A drip loop should also be provided on wires passing from one room to another where either moisture or corrosive vapors exist.

(B). Where wires pass through a wall of too great thickness to allow one continuous tube to be used, a continuous waterproof sleeve or pipe shall be used with a porcelain tube inserted from each end of the sleeve, butting together inside the sleeve.

(C). Where wires are run on under side of joists a substantial guard strip or running board must extend at least 1 inch beyond the wires on each side. Where necessary, 1/2

inch sides at least as high as the insulating supports must be provided.

(D). Where wires are to be installed in continually damp locations and where subject to drippings from piping, etc., a substantial inverted troughing is recommended with wires insulated on either regular solid or split knobs or the type knob shown in Circle No. 1. In such locations non-ferrous nails and screws should be used.

(E). Wires size No. 8 AWG or larger may be jumped from beam to beam without guard strip. In such construction it is recommended to space wires well apart.

(F). Where wires pass through floors or timbers in plaster partitions, tubes must be placed on wires above the floor or timber to protect them from damage by plaster and mortar which may accumulate in the partitions.

(G). Where wires are run on side walls within 7 feet of the floor they must be well supported and be protected from mechanical injury either by a wooden box with a slanting top through which wires must be insulated or (H) by a piece of iron pipe with wires properly insulated by continuous lengths of approved flexible tubing provided the length of the run does not exceed 15 ft.

(I). (Also circles 4 and 13). In making right angle turns in either cleat or knob and tube construction be sure there is no surplus wire. All wires must be drawn tight.

Also in making a short turn off the end of a tube, the turn should be off the head end so the pressure against the tube from the stretching process will tend to keep the tube tightly in place.

(J). (Also circle 5). Rigid supporting in most cases means at distances not over 4 1/2 ft. However, more frequent supporting may be necessary under severe conditions.

In concealed knob and tube wiring, wires must be spaced 5 inches from each other and 1 inch from the surface wired over, and on open cleat wiring 2 1/2 inches from each other and 1/2 inch from the surface wired over.

(K). (Also circles 11-18). Wherever one wire crosses another wire or a metal pipe or building member, a porcelain cross-over tube must be used. This cross-over tube must be fastened into position with regard to the conductor or metal member crossed.

Several wraps of a good quality friction tape will usually suffice. Regular cross-over tubes with two heads are available for the purpose.

(L). (Also circle 16). When using solid knobs the tie wire must be of the same or better insulation than circuit wire and must be wrapped around circuit wire at least three times on each side of the knob.

(M-N). Where wires enter a metal outlet, switch or receptacle box, each wire must be encased in a continuous piece of approved flexible tubing extending from the last support to the inside of the box. Flexible tubing must be securely fastened to the inside of the box or to an approved bushing.

It is no longer necessary to use metal boxes of any sort in connection with knob and tube wiring, as newly developed porcelain boxes are now available from any of the Standard Electrical Porcelain Manufacturers. These boxes are highly recommended as they eliminate largely any possibility of shock from accidental contacts in metal boxes.

### STANDARD ELECTRICAL PORCELAIN MANUFACTURERS

201 N. WELLS ST., CHICAGO, ILLINOIS

Ceramic Specialties Company  
East Liverpool, Ohio  
Illinois Electric Porcelain Company  
Macomb, Illinois  
Knox Porcelain Corporation  
Knoxville, Tennessee

Porcelain Products, Inc.  
Findlay, Ohio, Parkersburg, W. Va.  
Specialty Porcelain Works  
East Liverpool, Ohio  
Superior Porcelain Co.  
Parkersburg, West Virginia

Universal Clay Products Co., Sandusky, Ohio

TO BE SURE OF THE BEST!  
Specify and Use . . . . .

# ILLINOIS PORCELAIN

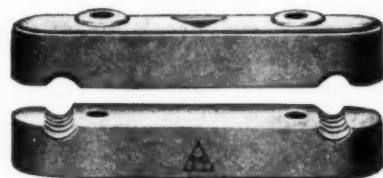
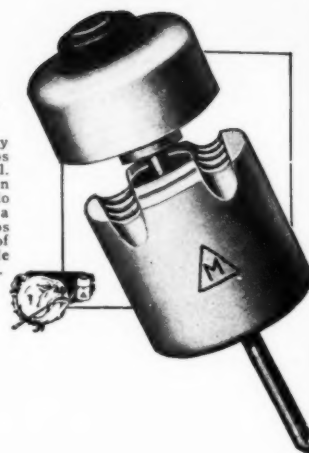
KNOBS  
TUBES  
CLEATS  
OUTLET BOXES  
SWITCH BOXES  
SERVICE ENTRANCE  
SWITCHES . . . . .

● Illinois Porcelain products are the assurance of dependable insulation and modern, neat jobs. Contractors, far and wide use these products and thereby not only establish themselves most securely with their customers but also build their business by making each job a true quality one. Don't overlook Illinois Porcelain possibilities for yourself—investigate this line now.

## KNOBS

Cement coated  
Extra length nail  
Genuine leather washer  
Code standard

Just a few reasons why Illinois Porcelain Knobs meet wide approval. They don't chip when driven in and they do stay in place and have a firm grip. Solid knobs available in a variety of heights, diameters, hole sizes, and groove sizes.



## CLEATS

A wide line of standard one, two and three wire cleats.

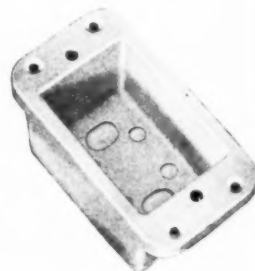


## TUBES

In sizes  $\frac{1}{2}$  to 48 inches long,  $\frac{5}{16}$  to 3 inch diameter in following types, unglazed, glazed, split, floor, split floor, headless, curved and curved end, Crossover split and Crossover. Diameters all uniform both inside and outside.

## SWITCH BOXES

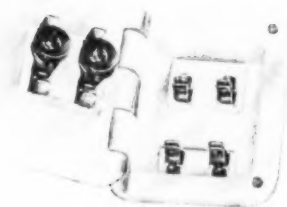
Made of the best quality of white porcelain, unglazed. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Insures greater safety in wiring and the elimination of all grounding hazards.



## OUTLET BOXES

Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes and mounting screws. The porcelain used in all Illinois

Products is of a special high grade insuring mechanical and electrical efficiency.



## SERVICE ENTRANCE SWITCH

A 30 Amp., 125 Volt Fused Entrance Switch with all porcelain box. Opening the cover breaks the circuit. Fuses are on the cover easily accessible and away from all live parts when the box is open.

**ILLINOIS ELECTRIC PORCELAIN COMPANY**  
**MACOMB ILLINOIS**

# The Maintenance Man SPEAKS HIS MIND



"I'm the house physician—I doctor sick machines . . . know them outside and in.

"When the super asks me about a safety switch, I say 'Look at the details. If the details are right, the safety switch is right.'

"I know. I've seen plenty trouble start from what were insignificant details when the switch was installed. That is why I say, give me a switch with parts that can't loosen from vibration . . . a handle that indicates positively when the juice is on . . . a mechanism that stays 'put' in the case . . . a scratch-proof non-marring finish that will not flake . . .

"I take no chances with the juice. I want a switch which tests out in every detail."

H. FOSTER

## WHY BOTHER ABOUT CONTACT PRESSURE?

If a safety switch looks right and works right—when you put it in—why be extra fussy about the pressure of the jaws on the blades?

Why?—because strong pressure is needed to make good contact. If pressure is weak, contact becomes faulty, heating develops and trouble begins, and it doesn't make any difference whether you are talking about a Type A switch, Type C or Type D. In the Cutler-Hammer line you do get proper contact pressure because Cutler-Hammer

—the leaders in current-carrying equipment—develop every detail to its utmost. Contact pressure may be a detail, but it is a mighty important one.

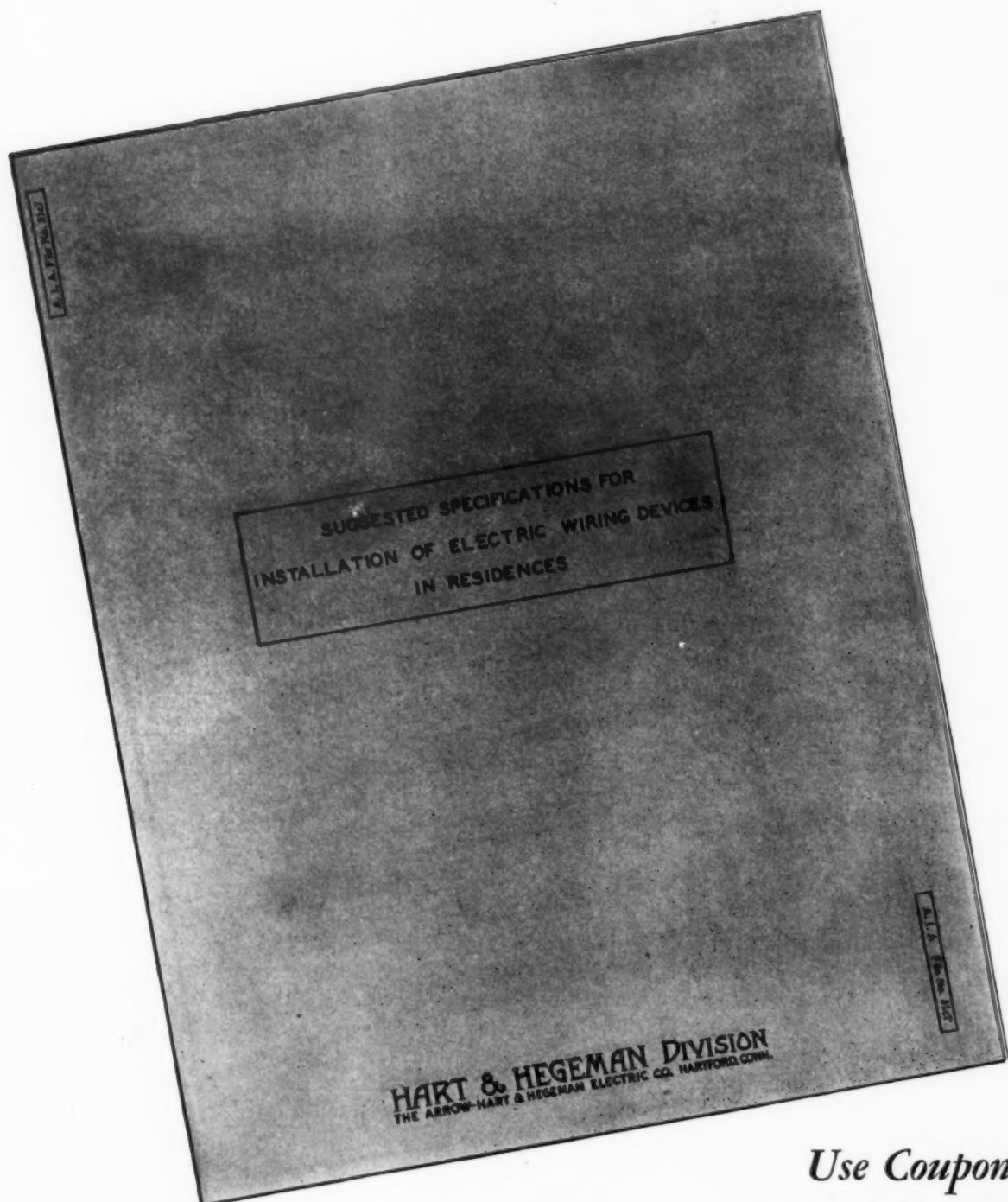
Why does Cutler-Hammer stress the importance of 100% perfection in every detail? You know the answer. You prefer to be known as the "100%" Contractor. Well, give us credit for a little pride too. CUTLER-HAMMER, Inc., Pioneer Manufacturers of Electric Control Apparatus, 1306 St. Paul Avenue, Milwaukee, Wisconsin.

● The C-H line includes all types and sizes of Standard, Weatherproof and Explosion-Proof Safety Switches, and Range Switches and Service Equipment for every locality—all built to the famous C-H Control Leadership Standards.



CUTLER-HAMMER  SAFETY SWITCHES

*Send for* **this manual**



*Use Coupon*  
on next page

**HART & HEGEMAN DIVISION**  
THE ARROW-HART & HEGEMAN ELECTRIC CO. HARTFORD, CONN.



# *to provide* **an adequacy of** electric outlets and switches in moderate-priced buildings

The most modest home, today, *must be modern*. Must be wired to the increasing needs of electrical appliances and wiring devices for more convenient living.

To provide an adequacy of electric outlets and switches in moderately priced residences we offer the manual, "Suggested Specifications for Installation of Electric Wiring Devices in Residences."

These specifications are drawn to assist you in planning installations and putting them through as planned, so your customers will have every reasonable or required provision for the electrical accommodations they expect in the modern home.

The first three pages are actual specifications which may confidently be used word for word. Then follow suggestions which point out where the different wiring devices may be indicated in your plans. Electrical symbols shown therewith may be drawn on each plan to accurately indicate what's wanted—and where.

Catalog data on the last four pages are divided into groups numbered according to the paragraphs or clauses of the *same number* in the actual specifications.

This simple plan of specifications may be enlarged for the more pretentious residence with complete confidence, although compiled primarily to apply to the moderate-priced home. The booklet comes to you with our compliments: — merely mail the Coupon properly filled out.

To HART & HEGEMAN DIVISION,  
Hartford, Connecticut

Send me your new manual, "Suggested Specifications for installation of Electric Wiring Devices in Residences."

(Name) \_\_\_\_\_

(Name of Company) \_\_\_\_\_

(Address) \_\_\_\_\_

(Town & State) \_\_\_\_\_

**HART & HEGEMAN DIVISION**  
THE ARROW-HART & HEGEMAN ELECTRIC CO. HARTFORD, CONN.

# BRYANT WIRING DEVICES

THE MASTER LINE FOR EVERY MASTER SPECIFICATION

Leading Architects, Engineers and Contractors specify "Bryant"—for quality, economy and long life. You, too, can use Bryant devices with complete confidence.

## FLUSH WALL SWITCHES



No. 5421



No. 4961



No. 3951



No. IL-1311

CAT. NO.	DESCRIPTION	AMPERES	
		125 Volts	250 Volts
5421	Single Pole, Indicating .....	20	20
5422	Double Pole, Indicating .....	20	20
5423	3-Point .....	20	20
5424	4-Point .....	20	10
5426	Single Pole, Quad. Break, Indicating .....	20	20
5431	Single Pole, Indicating .....	30	30
5432	Double Pole, Indicating .....	30	30
5433	3-Point .....	30	30
5434	4-Point .....	20	10
5436	Single Pole, Quad. Break, Indicating .....	30	30

4961	Single Pole, Indicating .....	10	5
4962	Double Pole, Indicating .....	10	10
4963	3-Point .....	10	5
4964	4-Point .....	5	2
4965	Double Pole .....	20	10
4966	Single Pole, Quad. Break, Indicating .....	20	10

3951	Single Pole, Indicating .....	10	5
3952	Double Pole, Indicating .....	10	10
3953	3-Point .....	10	5
3954	4-Point .....	5	2
3955	Double Pole, Indicating .....	20	10
3920	Single Pole, Quad. Break, Indicating .....	20	10

IL-1311	Single Pole .....	10	5
IL-1312	Double Pole .....	10	10
IL-1313	3-Way .....	10	5
IL-1314	4-Way .....	5	2

NOTE: For lock type, add "L" to any of above catalog numbers. Black handles furnished on special order. Standard handles are brown.



Fit standard deep switch boxes, single gang, and standard wall plates. Recommended for heavy-duty 20 or 30 ampere circuits in industrial, commercial and institutional buildings. Totally enclosed in bakelite casings. For lock type, add "L" to catalog number.

The ideal switch for control of all Type "C" lamp circuits. Specially-formed, silver-plated contacts assure long life at full rated loads. Totally enclosed. Meets all government specifications. The correct switch for banks, industrial plants, hospitals, schools, fine residences, office buildings and theatres.

A porcelain-cup switch with operating features which make it suitable for apartment, residential, small commercial and other medium-duty applications.

"Interchangeable" switches, designed so that as many as three switches, receptacles, pilot lights, etc., may be installed—in any desired combination—under a single-gang plate. Excellent for residential and commercial jobs, and wherever space economy is important.

For small jobs, where first cost is the only factor, and loads are light, we suggest:

H51 — Single Pole switch, 10A. 125V.; 5A. 250V.  
H53 — 3-Way switch, 10A. 125V.; 5A. 250V.

THE BRYANT ELECTRIC COMPANY • BRIDGEPORT, CONNECTICUT

NEW YORK: 100 East 42nd St. • CHICAGO: 844 West Adams St. • SAN FRANCISCO: 325 Ninth St.

# BRYANT THE MASTER LINE FOR EVERY MASTER SPECIFICATION



No. 4812

## FLUSH RECEPTACLES

### No. 4810 Single; No. 4812 Duplex

The perfect device for all quality jobs: Industrials, hospitals, banks, stores, theatres, fine residences, schools, office buildings. Top wired, bakelite casing, finest internal construction.



No. 4832

### No. 4831 Single; No. 4832 Duplex

A rugged, reliable receptacle particularly adapted for installation in small commercial, residential and apartment buildings.



No. IL-1320

### No. IL-1320

An "Interchangeable" receptacle; as many as three may be used in one gang, or they may be combined with interchangeable switches, shown on preceding page.

Where first cost is the deciding factor, Specify: H141 Single, H142 Duplex.



No. 3846

## RESIDENTIAL SPECIALTIES

Specify Bryant No. 3846 Flush Range Receptacle for every "Electric Kitchen." Provides convenient range connection, and range can be removed at any time without requiring services of an electrician. For surface installations specify No. 3826.



No. 2355

Door switches save money; lights can never be left burning in closets with this device on guard. Specify No. 2355 if light is to be "ON" when door is open; No. 2356 if light is to be "OFF" when door is open. Supplied complete with outlet box, plate and round "strike plate."



No. 4275

Specify Bryant Outlet Box Lamp Receptacles for closets, attics, basements, garages, etc. Also desirable for commercial and industrial use. Made in keyless, and pull chain types, to fit 3 1/4" or 4" outlet boxes.

## FLUSH WALL PLATES



You can safely specify "Bryant," no matter what your wall plate requirements. Plates are made in .040", .060", and .100" solid brass or in bakelite. They may be furnished in special sizes, or with raised edges, square edges, or round corners. They may be engraved with letters or numbers of any size. And

Bryant will plate, lacquer or enamel any wall plate to match building hardware, marble, or other decorative architectural features. Bryant makes multiple-gang plates for any desired combination of switches, receptacles, bulls' eyes, or other flush wiring devices.

## SPECIAL USE RECEPTACLES



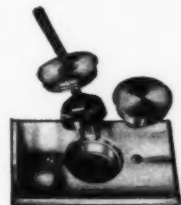
No. 2828

No. 2828. Clock Hanger Outlet, complete, ready for installation. Clock hangs from hook, and cord folds out of sight into pocket. A real necessity in kitchens, halls, living rooms; in offices, stores, libraries, public buildings, institutions, banks.



No. 3750

No. 3750. Fan Hanger Outlet complete with plate and mounting yoke. This device should be installed wherever a fan is likely to be used: In offices, hotel rooms, residences, apartments, auditoriums, public buildings, institutions, banks.



No. 3798

No. 3798. Floor Outlet, complete with solid brass screw covers. Designed particularly for residential and apartment installation. Has square edged plate. For bevel-edged plate, specify No. 3799.



No. 3795

No. 3795. Outdoor Receptacle, complete with screw-cap. Permanently weather-proof, this device is ideal for residential jobs—for outdoor terrace extensions, decorative lighting, etc., and for general industrial and commercial outdoor applications.

Specify "Bryant." There is a Bryant device for every requirement. For complete information, see Catalog No. 34.

**THE BRYANT ELECTRIC COMPANY • BRIDGEPORT, CONNECTICUT**

NEW YORK: 100 East 42nd St. • CHICAGO: 844 West Adams St. • SAN FRANCISCO: 325 Ninth St

# "...or equal"

will be difficult to find if you specify  
**SANGAMO TIME-SWITCHES**

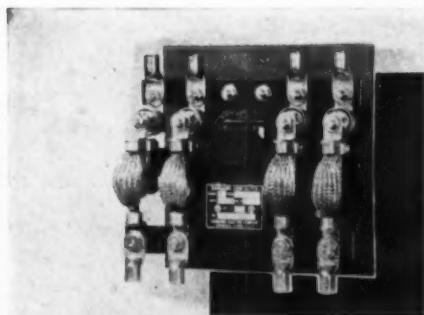
*for*

Window Lighting  
Signs  
Floodlighting  
Ventilation, etc.

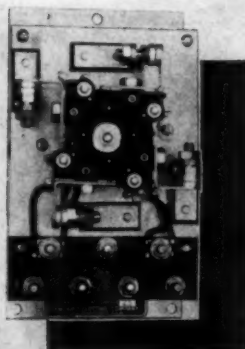
To provide "on" and "off" operations automatically at pre-determined periods — that is the function of any time-switch. But to do this with unfailing dependability . . . with absolute accuracy . . . *for years* — that is the assurance when a Sangamo Time-Switch is specified. Truly, an "equal" will be hard to find.

Here are a few installations which can be made completely automatic (and often money saving for the owners) by specifying a Sangamo Time-Switch:

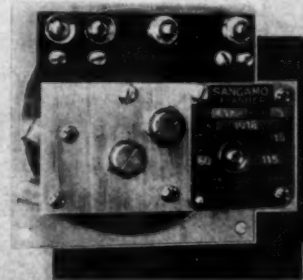
Oil burner control	Electric sign control
Ice machine defrosting	Ventilation control
Apartment house lighting control	Display window lighting control
Beacon lighting control	Poultry house lighting control
Floodlighting control	Blower operation control
Airport lighting control	Automatic stoker control
Traffic lighting control	Motor control
Billboard lighting control	Oil filter control



13



12



11

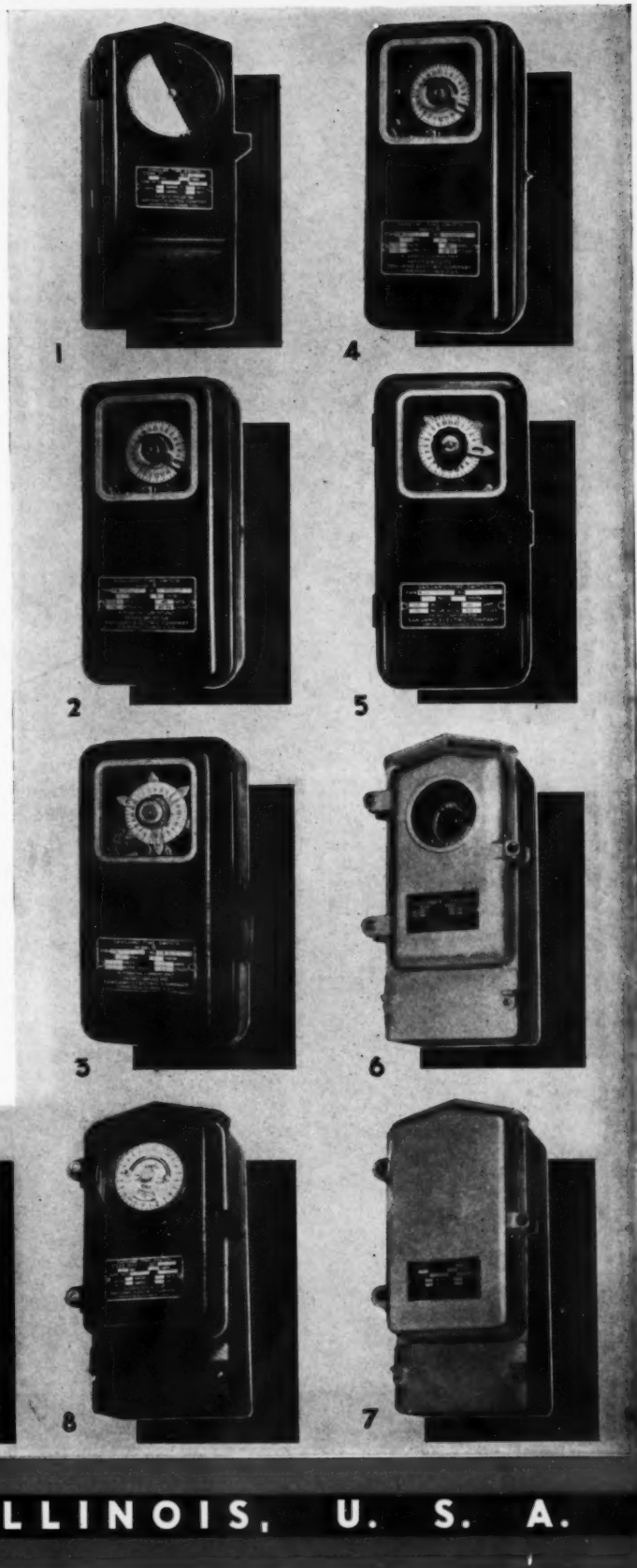
**SANGAMO ELECTRIC COMPANY**



# A Complete Line for All Time-Switch Requirements

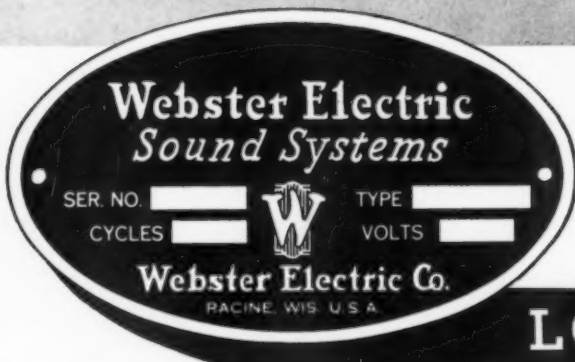
- 1 Type TC. Electrically wound—full jeweled escapement—for either alternating or direct current.
- 2 Type TW. Moderately priced, direct current Time-Switch.
- 3 Form VS Synchronously motored—equipped with omitting device.
- 4 Form VW Electrically wound with 10 hours reserve, and omitting device.
- 5 Type K Synchronously motored—without omitting device.
- 6 Form VSO—VS Switch for outdoor installation.
- 7 Type TCO. TC Switch for outdoor installation—supplied with or without window.
- 8 Type TCZ. TC Switch equipped with "astronomic" dial.
- 9 Form VSZ. VS Switch equipped with "astronomic" dial.
- 10 Form VS or VW Time-Switch combined with Flasher, in various combinations, will produce any flashing effect or time-switch control desired.
- 11 Model 3 "off and on" flasher fills the need for a small, inexpensive but dependable flasher.
- 12 Model 2 "Chaser" flashers—may be installed inside sign, reducing installation cost.
- 13 Model 6-6164 Contactor to supplement time-switches and flashers for larger current circuits.

The new Sangamo Time-Switch Catalog will be helpful when preparing specifications.



Y SPRINGFIELD, ILLINOIS, U. S. A.

# THERE IS MONEY IN



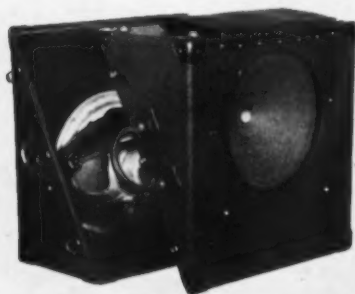
There is a lot of money to be made in selling sound equipment. People are insisting that sound equipment be installed in the places where they spend their money. They want to be entertained. They want to be able to hear as well as see what is going on.

But they are critical. They want to be able to hear *clearly*, to understand *better*. They want their music brought to them in *clear, sharp, undistorted tones*. This is impossible with any but the *highest quality sound equipment!*

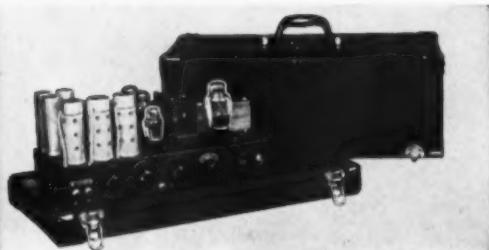
## LOOK FOR THIS LABEL



This is the Webster Electric 30 watt, Class "A" all-purpose, semi-portable sound system. This system will handle two crystal microphones, phonograph unit and the two 12" dynamic speakers shown below.



These two 12" dynamic speakers can be used with the 30 watt system shown above or the 15 watt system shown below. They assemble into a compact carrying case. An ample foot-age of speaker cord is included.



This is the Webster Electric 15 watt Class "A", all-purpose, semi-portable sound system. It includes virtually the same equipment as the 30 watt system. It is ideal for a wide range of purposes.

There is big profit awaiting the contractor who sells and installs quality equipment. Only grief awaits those who handle any but a line of the very highest quality.

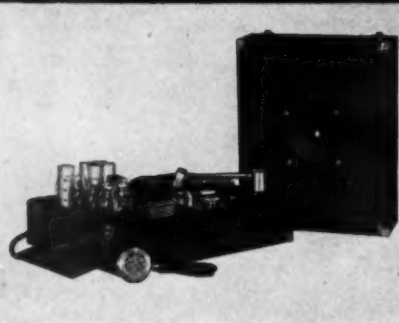
### Each of these complete sound systems bears this quality label

Illustrated here are five units. Each one bears the quality label pictured above.

This label reads "Webster Electric." It is a mark of outstanding quality. Do not confuse it with any other in which the word *Webster*, alone, appears as part of a corporate name. There is only one "Webster Electric." It identifies **QUALITY!**

### Webster Electric quality sound equipment is fully licensed!

If you are now selling a line of sound equipment, check up and be sure it is a fully licensed line. Webster Electric Sound Equipment is fully licensed. You are fully protected if you concentrate your efforts on Webster Electric.



This is a compact sound system in combination with a phonograph unit. It includes a hand-type crystal microphone, one 10" dynamic speaker with 25' of cord. Its easy portability gives it a wide range of utility.



Here is a light, compact, mobile 6-volt sound system that can be operated from a 6-volt battery. It includes new, spherical type microphone, necessary cord and two 12" heavy duty dynamic speakers.

# WEBSTER ELECTRIC

# Quality SOUND EQUIPMENT

If you are not now selling sound equipment, you should investigate its profit possibilities. There are over fifty different lines of business to which you can easily sell Webster Electric Sound Equipment.

These businesses are now sold on sound. They want it. Many of them are right around your place of business, only waiting for you to demonstrate a *quality* product.

IT'S A QUALITY MARK

In addition to those already sold on sound, there are over 172 other lines of business that are interested. *Consider the profit that is waiting for you!*

## Electrical Contractors are the logical sales outlets!

When you sell Webster Electric Sound Equipment you make a profit, not only on the equipment, but on its installation. Selling Webster Electric Sound Equipment fits right into your business.

Your business is the logical sales outlet for sound equipment. When people want sound equipment, they want to buy it from the man who has the knowledge, tools and experience to wire and install the job properly.

## Webster Electric Sound Equipment sold only through legitimate channels!

When you sell Webster Electric Sound Equipment you are fully protected against cheap competition. Webster Electric Sound Equipment is sold "clean"—at quality prices and at discounts that assure you the proper margin.

The high quality of this equipment, plus the fact that it is not obtainable through mail order houses, "gyp" dealers and "basement sound engineers," guarantees you a market *that will carry a profit* not possible with sound equipment of lesser quality that is sold on a "you-can-get-it-anywhere" basis.

## Install a demonstrator!

Prove to your own satisfaction that Webster Electric Sound Equipment will build profits for you. Install a small system as a demonstrator in your store or equip your truck with one.

This will attract customers. It will interest them in sound

equipment. It will prove to them that they can do more business by installing sound. It will actually create business for you. Order a demonstrator from your wholesaler or order direct, with instructions to ship through the jobber with whom you do business.

## Be sure it is Webster Electric, Racine, Wisconsin

When ordering your demonstrating system, be sure to specify WEBSTER ELECTRIC, MADE IN RACINE, WISCONSIN. *Do not use the name Webster alone.* There is only one Webster Electric Company. Address your order to Racine, Wisconsin and be sure!

## Write . . . right now . . . for the complete Webster Electric Sound Equipment story!

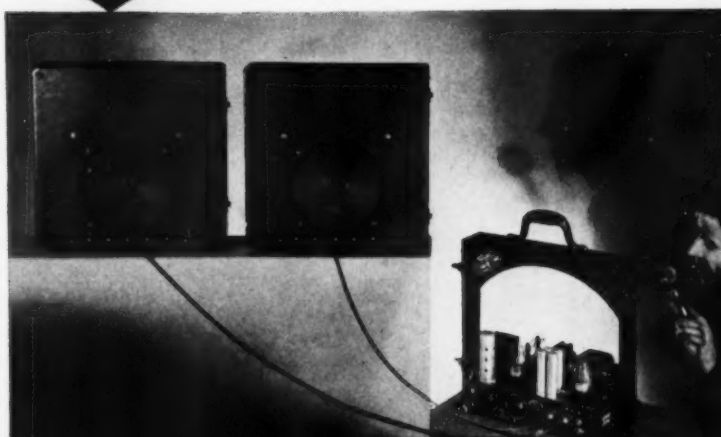
Find out right now how you can make additional profit selling high quality sound equipment. A letter—giving us your jobber's name—will bring you the preliminary details of how we can help you sell QUALITY Sound Systems!

## WEBSTER ELECTRIC COMPANY

RACINE • WISCONSIN • U. S. A. • ESTABLISHED 1909

Export Department:

15 Laight St., New York, N. Y.



# SOUND EQUIPMENT





AS WE EMERGE FROM THE DEPRESSION  
IT IS ENCOURAGING TO NOTE THE  
INCREASING DEMAND FOR  
QUALITY MATERIAL

IT IS TIME  
TO REMIND YOU THAT THE



**QUALITY**  
REMAINS  
LONG AFTER THE PRICE IS FORGOTTEN



**MATERIAL**  
INCLUDES

LIGHTING AND FEEDER BRANCH  
PANELBOARDS AND CABINETS.

SERVICE EQUIPMENT, SMALL AND LARGE CAPACITY.

METER CONTROL PANELBOARDS AND CABINETS.

LIVE FACE AND DEAD FRONT SWITCHBOARDS.

STAGE SWITCHBOARDS. MOBILE SWITCHBOARDS.

JUNCTION—PULL—AND TELEPHONE BOXES.

FLOOR BOXES—HANGER OUTLETS.

HEATERS, BUILT IN—PORTABLE.

**Frank Adam**  
ELECTRIC COMPANY  
ST. LOUIS



# CASH IN *Now*

SELLING ELECTRIC VENTILATION

Send for the  
**1936**  
American  
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PLANS**



Tells you how and where to sell electric ventilation, contains samples of new literature (furnished free to you) and outlines our new mailing plan whereby we mail literature for you free of charge. Write for your copy today—no cost—no obligation to you.

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Division of American Radiator and  
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Please send me a copy of the 1936 American Blower Blue Book. I understand there will be no charge or obligation for this. Mail to

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City and State \_\_\_\_\_

# USE THIS CHART AS YOUR GUIDE TO SPECIFICATIONS ON THE BENJAMIN EQUIPMENT LISTED IN CATALOG 26

**Turnlox RLM Dome**



Catalog Page 32

**Turnlox Glassteel Diffuser**



Catalog Page 45

**Turnlox Elliptical Angle**



Catalog Page 36

**Alzak Aluminum Fixtures**



Catalog Page 89

**Mercury Vapor Lamp Fixtures**



Catalog Page 256A-1

**Explosion Proof Fixtures**



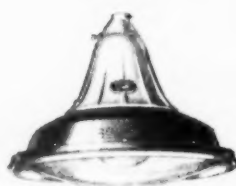
Catalog Page 125

**Type II-G Dust Tight Fixtures**



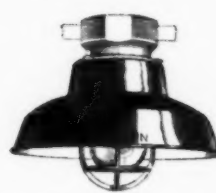
Catalog Page 129

**Vapor-Seal Fixtures**



Catalog Page 132

**Vapolet Fixtures**



Catalog Page 138

**Intensifier**



Catalog Page 76

**Projectolite**



Catalog Page 78

**Dust Tight Cover**



Catalog Page 115

**Emblem Sign Reflector**



Catalog Page 87

**Rexide Sign Reflector**



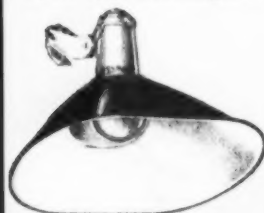
Catalog Page 86A-1

**Master Sign Reflector**



Catalog Page 82

**Open Type Floodlights**



Catalog Page 168

**Kode-Kall Device**



Catalog Page 242

**Bells and Chimes**



Catalog Page 249

**Signal Horns**



Catalog Page 244

**Floodlight Projector**



Catalog Page 187

**LIGHTING**

**BENJAMIN**  
TRADE MARK

**EQUIPMENT**

**BENJAMIN ELECTRIC MFG. COMPANY GENERAL OFFICE AND PLANT DES PLAINES, ILLINOIS**

Lamp

66A-14

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e 76

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e 82

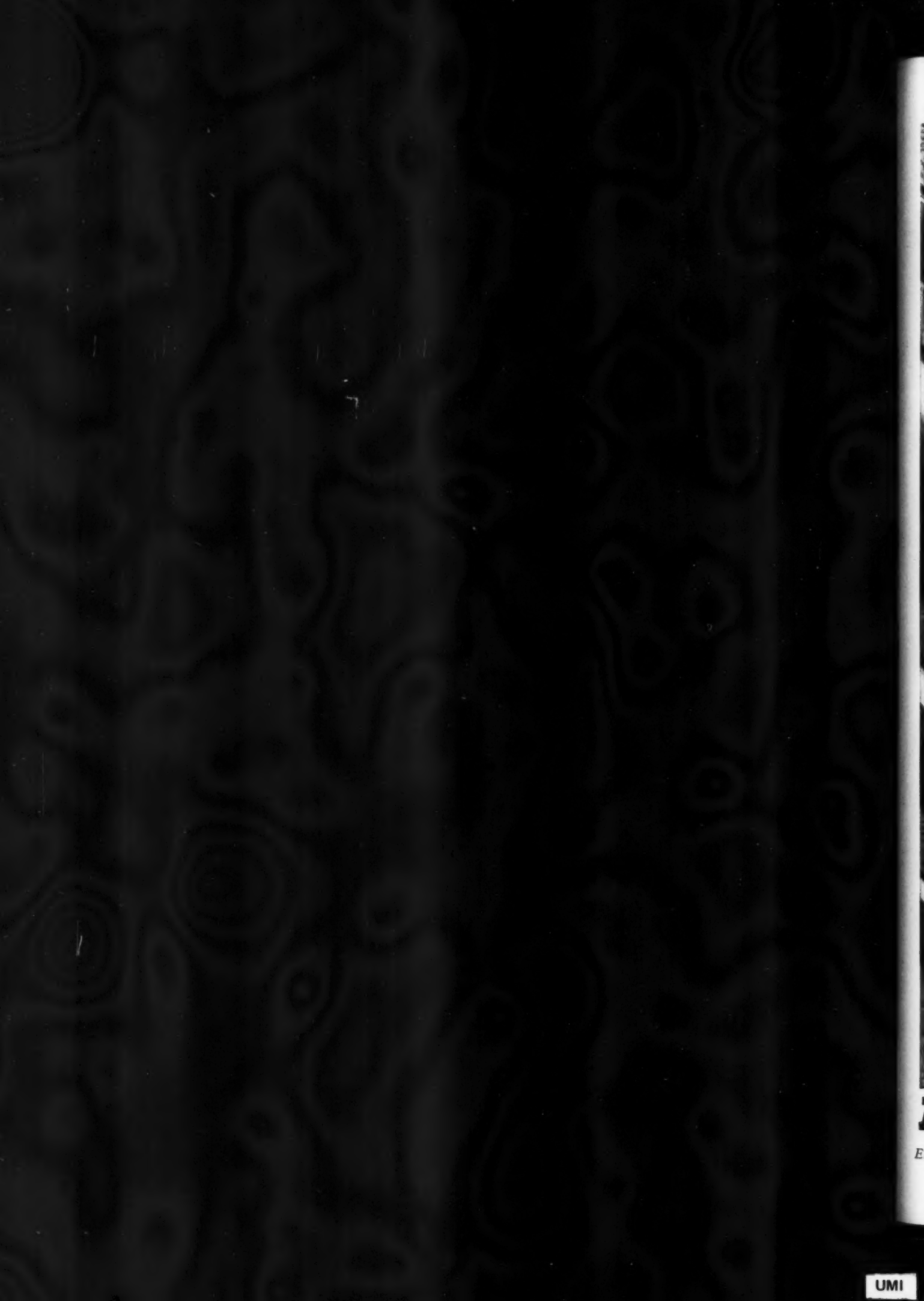
jector



e 187

EN

NOI



E



# Specify and Use

this durable, non-rusting, corrosion-resistant

## EVERDUR ELECTRICAL CONDUIT

- 1** Where various chemicals are prevalent in surrounding air, soil or construction materials.
- 2** In atmospheres containing ammonia fumes, bone dust, etc.
- 3** In humid atmospheres, and areas where unusual atmospheric condensation takes place.
- 4** In coastal areas, or wherever salt atmospheres are encountered.
- 5** In atmospheres containing smoke, soot or industrial gases.
- 6** In hazardous locations where atmospheres are charged with metal dust, carbon black, coal, coke or grain dust.
- 7** Wherever ethyl ether, gasoline, common petroleum, ethyl alcohol, methyl alcohol, acetone or lacquer solvent vapors are encountered.
- 8** Wherever permanence and freedom from repairs and replacement is desired.

Everdur\* Electrical Conduit was developed by The American Brass Company to meet a long-felt need for a more durable conduit. It is manufactured in standard sizes and in two wall thicknesses, electrical metallic tubing (E.M.T.) and rigid conduit (R.C.) and is listed and labeled by Underwriters' Laboratories. It may be obtained from authorized jobbers of electrical supplies. \*Reg. U. S. Pat. Off.

Everdur Electrical Conduit is strong, durable, and highly resistant to a wide range of corroding agents. Of uniform temper and size, it can be cut, threaded, bent and assembled with the same equipment used for steel conduit or tubing. Several complete lines of threaded and threadless Everdur Fittings are available. Publication E-12 gives detailed information and will be mailed on request.

### THE AMERICAN BRASS COMPANY

Buffalo Branch: 446 Military Road, Buffalo, N. Y.

Offices and Agencies in Principal Cities



EVERDUR METAL: "EVERDUR" is a registered trade-mark, identifying products of The American Brass Company made from alloys of copper, silicon and other elements.

# ANACONDA COPPER & BRASS

# APPLETON ELECTRIC PRODUCTS



Type "C"—Threaded  
Rect. Unilet



Type "LL"—No-Thread  
Rect. Unilet



Type "G"—Form 35  
Unilet



Type "LB"—  
Form 35 Unilet



Type "FSC" Unilet



Type "H" Unilet



Type "GRUST"  
Explosion-Proof Unilet



Type "CPSIC"  
Explosion-Proof Unilet



Connector for  
Electrical Metallic Tubing



Coupling for  
Electrical Metallic Tubing



Connector for  
Armored Conductors

WHEREVER a neat, quick and economical job of wiring is desired, Malleable Threaded and No-Thread "Unilets" are invariably preferred. This preference is due largely to their individual design and manufacture. And being adaptable to any fitting requirement, they simplify installation operations and reduce material and labor costs.

There are fittings and fittings—good, bad and indifferent. However, results alone count.

The results secured through Appleton Fittings have been responsible for their rapid adoption for varied wiring requirements. For years they have been bought on their merits. Light in weight, strong, these fittings are easily handled and installed. Large wiring spaces, smoothly finished, and the fact they fit snug to ceiling or wall, insures a neat, quick and economical finished job, saving valuable time and labor.

Low transportation charges and elimination of breakage in handling and shipping, coupled with Appleton distribution—quick service—are further reasons for standardizing on Appleton fittings to decrease costs and increase profits.

Write for Catalogs and Bulletins on complete line of Appleton Unilets and Conduit Fittings.

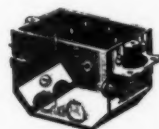
**APPLETON ELECTRIC COMPANY**  
1704 WELLINGTON AVENUE CHICAGO, U.S.A.

New York, 76 Ninth Ave.  
Philadelphia, 401 North Broad St.  
San Francisco, 655 Minna St.

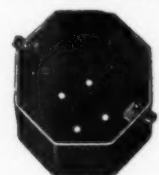
Los Angeles, 340 Azusa St.  
Detroit, 7621 Woodward Ave.  
St. Louis, 420 Frisco Bldg.



4-in. Oct. Outlet Box



No. 44 Switch Box



OCR—3 1/2-in.  
Concrete Box



Fitting for  
Service Entrance Cable



Connector for Service  
Entrance Cable



Locknuts and  
Bushings



Fixture Stems

## APPLETON UNILETS

and CONDUIT FITTINGS

Reg. U. S. Patent Office



# 3200 Line

—OF DUPLEX SWITCHES,  
RECEPTACLES & PILOT  
LIGHTS

**THE POPULAR CHOICE OF THE INDUSTRY**

Particularly suited for residential,  
commercial and institutional jobs.

**Circle F is the pioneer manufacturer of such devices.**



3201



3202



3209

	Specify No.
For 1 S.P. Switch & Receptacle.....	3201
For 2 S.P. Switches, Common Feed.....	3202
For 1 S.P. and 1 3-Way Switch, Common Feed	3203
For 1 S.P. and 1 3-Way Switch, Separate Feed	3204
For 2 Three-Way Switches.....	3205
For Selector Switch (1 & 2 Circuit Switch).....	3206
For Pilot Light and Receptacle.....	3207
For Pilot Light and S.P. Switch.....	3208
For Dimmer Switch (Triple action, Series Dimming).....	3209
For 2 S.P. Switches, Separate Feed.....	3210



3207



3208

Standard Duplex Receptacle Plates  
used with all above devices.

**Everything in Quality Wiring Devices—Write for Information**

**CIRCLE F MFG. CO.**

720 MONMOUTH ST.  
TRENTON, NEW JERSEY

RIKER'S ISLAND PENITENTIARY \* CHICAGO POST OFFICE \* PENNSYLVANIA RAILROAD STATION, PHILADELPHIA

GEORGE WASHINGTON BRIDGE \* INLAND TERMINAL BUILDING, NEW YORK

\* ATLANTIC CITY AUDITORIUM \* \* HOTEL NEW YORKER, NEW YORK \* \* WHITE HOUSE, WASHINGTON



CHICAGO POST OFFICE, CHICAGO, ILLINOIS



47  
YEARS

OF KNOWING HOW

# CRESCENT CABLE

*after the job (Chicago Post Office) was completed, Mr. A.S. Schulman told us that his total labor cost was considerably less than he estimated it would be due to the excellent finish and flexibility of CRESCENT WIRE*

**CRESCENT**  
INSULATED WIRE & CABLE CO. INC.  
TRENTON, NEW JERSEY

DEPARTMENT OF AGRICULTURE, EXTENSIBLE BUILDING, WASHINGTON, D. C.



6

SERV  
Type KI  
See Per  
Catalog

PIT  
PGK  
for i  
prices

TA  
Type  
See  
Cata

PI  
Type  
See  
Cata

UR

# For SAVINGS SPEED SAFETY

Burndy Connectors will save you money. They eliminate soldering waste; they cut labor costs to the bone; they are insurance against outage losses. A man! A wrench! A minute! The result: A trouble free connection, destined for a lifetime of efficient service. Think of it: You can make a sound, permanent connection on any size cable up to 2,000 Mcm... on any type conductor—stranded cable, solid wire, flat bar, tube... for any combination of conductors... with a few turns of an ordinary wrench. Burndy Connectors will withstand maximum wrench torque values; they will not burn out on overload; they are not affected by vibration or strain. Burndy Connectors are approved by Underwriters' Laboratories. These qualities, plus the fact that Burndy's large stock permits prompt shipments, are the reasons that these connectors are preferred by electrical contractors.



# USE

# BURNDY

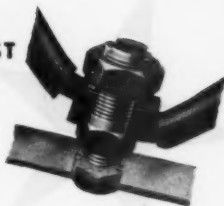
## ELECTRICAL CONNECTORS



**SERVIT**  
Type KS  
See Page 22,  
Catalog 33C

### SERVIT POST

Type KN  
See Page 25,  
Catalog 33C



**SCRULUG**  
Type KPA  
See Page 9,  
Catalog 33C

**PIT**  
Type PKG  
See Page 10,  
Catalog 33C



**GUTTER TAP**  
Type QP  
See Page 16,  
Catalog 33C

**TAPIT**  
Type PG  
See Page 17,  
Catalog 33C



**A-CLAMP**  
Type AF  
See Page 32,  
Catalog 33C



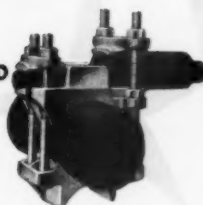
**BUTTIN**  
Type KP  
See Page 24,  
Catalog 33C



**QIKLUG**  
Type QAU  
See Page 7,  
Catalog 33C

### PIPE GROUND

Type GWC  
See Page 42,  
Catalog 33C



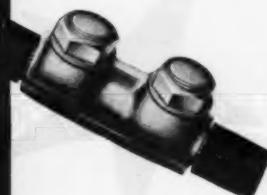
**QIKLUG**  
Type QA-90  
See Page 5,  
Catalog 33C



**QIKLUG**  
Type QA  
See Page 3,  
Catalog 33C

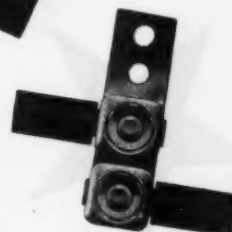
### BRANCH

Type QY  
See Page 13,  
Catalog 33C



**QIKLINK**  
Type QS  
See Page 15,  
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**QIKLUG**  
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**QIKSTUD**  
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### TWIN LINK

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**BAR TAP**  
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**QIKTAP**  
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**QIKLUG**  
Type Q3AJ  
See Page 7,  
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## TRADE STANDARDS

are created, not by intensive advertising  
or salesmanship, but established by the  
experience and approval of the  
trade over a period of years.

# CLIFTON PRODUCTS are a TRADE STANDARD

*Write for our new catalog  
containing complete material  
and engineering data on all  
Clifton Products*



Electrical Metallic Tubing and  
Fittings

Rigid Conduit, Black and Hot  
Galvanized

Flexible Steel Conduit

Armored Cable

Non-Metallic Flexible Conduit  
(Loom)

Non-Metallic Sheathed Cable

Service Entrance Cable and Fittings

Trenchlay and Parkway Cables

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All standard and special types of  
wire, cable and cords.

All-Rubber Cords

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National Sales Representatives

**HATHEWAY & CO., INC.**

220 Church Street

New York City



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From the doorbell of a bungalow to complete protection of Rockefeller Center requiring fifty-eight miles of wire; from a small doctor's office in Toledo to the largest hospital in Tokyo; every audible and visible signaling device or system is in your Edwards catalog. Every Edwards office will give sympathetic attention to your signaling problem, large or small.

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NOZZLE**

Showing the No. 295  
Nozzle Mounted on  
Cover of No. 130  
Adjustable Floor Box.



**NO. 300 "LATROBE"  
MIDGET FLOOR RECEPTACLE  
AND BOX**

The only non-watertight floor re-  
ceptacle and box on the market  
approved by the Underwriters lab-  
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floors.



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No. 130 Box with No. 207  
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illustrates how tapered unit  
receptacle fits tapered opening  
in adjustable ring. Design  
eliminates many small parts.  
Cover plate 3 1/4" — overall  
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**No. 330 "LATROBE"  
TOM THUMB  
UTILITY OUTLET**

For use in wood installa-  
tions, and other locations  
free from moisture or me-  
chanical injury.



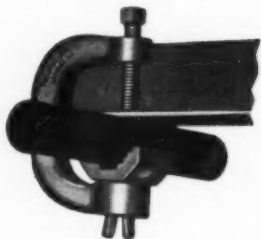
**NO. 252-R TWO GANG BOX**

Two gang Adjustable Floor Box with  
No. 208 Receptacle in one section. One  
cover plate with 1/2" Flush Brass Plug  
and the other cover plate with 2" Flush  
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CABLE SUPPORT**

A new, lightweight, strong clamp for  
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framework. Permits hanging from any  
angle. Best and most economical way  
of temporarily or permanently installing  
armored cable in buildings of steel  
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CONDUIT HANGER**

Pipe support can be turned freely, per-  
mitting pipe to run parallel, or at right  
angles to beam. Eliminates drilling or  
use of straps. Will accommodate sizes  
of 1/2", 3/4" and 1" pipe to steel beams  
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Fullman also offers Insulator Supports,  
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*"Latrobe"*  
FLOOR BOXES

AND WIRING SPECIALTIES

The Fullman reputation for quality devices is your as-  
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The complete Fullman line offers a floor box for  
every application. Write for catalog and price list,  
and on future jobs, specify "Latrobe."



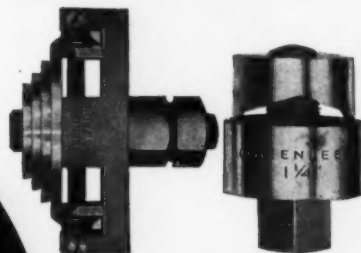
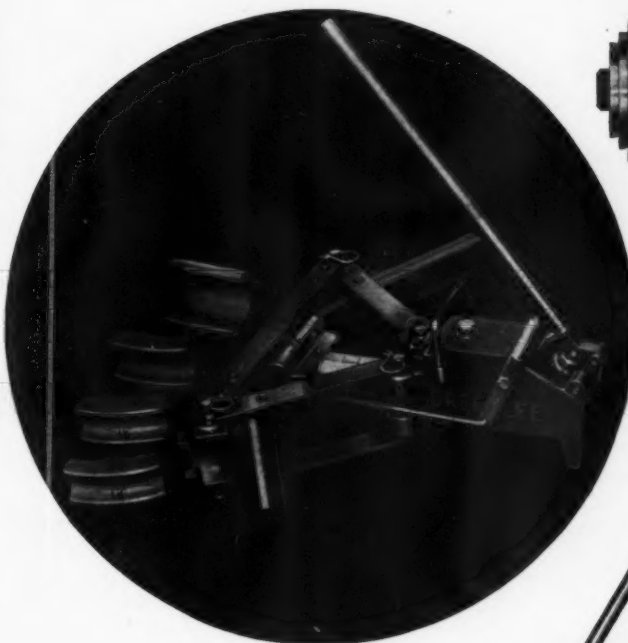
**FULLMAN MFG. CO. LATROBE  
PENN.**

# Better TOOLS make BETTER WIRING JOBS and greater profits

## Greenlee Boring Tools

For boring holes at high speed, use the No. 31 Electricians' Bit, which is known as the fastest boring tool on the market. It has a double-spur head for long life and a coarse screw point for fast feed. Other popular types of bits for the electrician are also included in the Greenlee line.

When an extra long reach is needed, a Greenlee Bit Extension is the ideal tool. The No. 900 will drive bits up to 1-inch diameter and is small enough to follow a 5/8-inch tool. A positive lock always prevents the bit from coming loose and being lost in the work. Made in a variety of lengths, and a larger size for bits up to 2-inch is also available.



## Greenlee Knockout Tools

These tools enlarge holes in outlet boxes, switch cabinets, etc., quickly and accurately, without filing or reaming. No. 735 Punch Set is for 1/2, 3/4, 1 and 1 1/4-inch conduit, while the No. 737 Set is for 1 1/2 and 2-inch conduit. No. 740 Cutter will enlarge holes for 1 1/2, 2, 2 1/2 and 3-inch conduit.



## Greenlee Hydraulic Pipe Pusher

The No. 790 Pusher saves much time and labor. Easy for one man to operate. Has capacity for 4-inch and smaller pipe and will exert a maximum pressure of 40,000 pounds on the pipe clamp.

## Rigid Conduit Benders

Above is the Greenlee No. 770 Hydraulic Bender for rigid conduit. By pumping the handle, a shoe on the ram is forced against the conduit, which is held at two points by formed support castings. It makes smooth, even bends faster and easier than by any other method. It is simple to operate and easy to take to the job. No. 770 bends all sizes of conduit from 1 1/4 to 3-inch. The larger bender, No. 775, handles all sizes from 2 1/2 to 4 1/2-inch.



## Thin-Wall Steel Conduit Bender

The Greenlee No. 770-T Hydraulic Bender is the solution to the problem of how to bend thin-wall conduit quickly and without crushing. Same power unit as No. 770, but with different attachments. Will handle 1 1/4, 1 1/2 and 2-inch sizes.

On every job where conduit is to be bent, knockouts enlarged, holes bored, or pipe pushed through the ground, Greenlee Tools can be used to advantage. The reason is that they save money by doing the jobs faster, better, and with less effort for the workman.

Take the Greenlee Hydraulic Conduit Bender as an example. Here is a tool that not only makes bends faster and easier, but it makes better bends, eliminates the need for many manu-

factured fittings, and makes it easier to pull in wire and cable. So satisfactory have these tools performed that a number of contractors have written us that their bender paid for itself on the very first job.

This can easily be true of the other tools shown here, and of the Greenlee Ball Bearing Joist Borer. Each one is a time saver and worth investigating. Complete details will be sent, gladly.

Mail  
this  
coupon  
today

GREENLEE TOOL CO., ROCKFORD, ILL.

Please send information on the following tools:

☐ Rigid Conduit Benders

☐ Thin-Wall Conduit Benders

☐ Pipe Pushers

☐ Knockout Tools

☐ Joist Borers

☐ Electricians' Bits

☐ Bit Extensions

Name.....

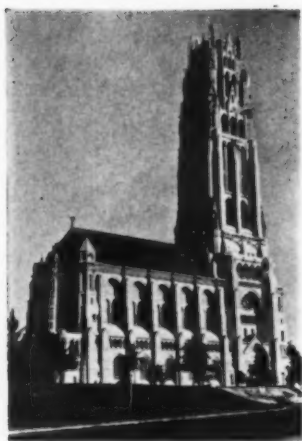
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City.....

State.....

My Jobber is.....

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CHURCHES

## where are REMOTE CONTROL SWITCHES used ...AND WHY?

"Diamond H" Remote Control Switches were specified and used to control the many and varied types of lighting circuits used on these jobs.

Why were they specified and used?

Primarily because some electrical contractor or engineer knew that "Diamond H" switches would provide simple, easy and convenient means of instantly lighting one or hundreds of lighting circuits. Also because "Diamond H" switches are dependable, economical because they save wiring costs, and are the best kind of lighting control insurance.

Why be old fashioned! Flip a toggle and instantly hundreds of lights spring into action.

Remote Control switches have wide application. Every job is a possibility. Know about them and how to use them. Bulletin 10-A and the Don Graf data sheets illustrate the different types with wiring plans, so that you can apply them to your jobs. Sent free on request.

The services of our engineering department are offered to aid in correctly applying the different types. Use this service.

*We make many types of relays that can be used for lighting control, also industrial switches for motorized equipment.*

The HART MFG. CO.  
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USE

DIAMOND **H** SWITCHES



COLLEGES and SCHOOLS



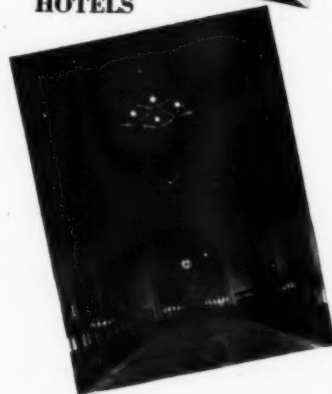
AUDITORIUMS



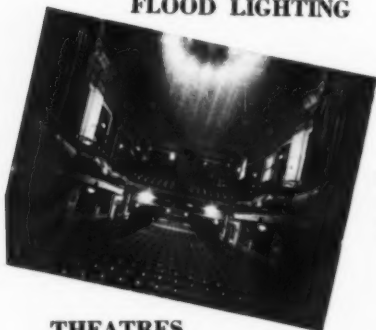
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FLOOD LIGHTING



BANKS



THEATRES



SIGNS



# KILLARK Flat-Backed FITTINGS

*Easily and quickly installed  
Make a more workmanlike job  
Cut installation costs  
Make truly uniform jobs possible*

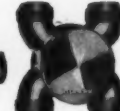
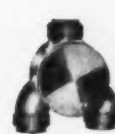
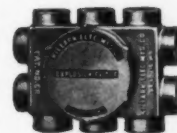
Because conduit fittings must be hand-installed and adjusted with all faces aligned, the flat-back is a very important factor in quick and efficient installation.

The shape of Killark fittings was chosen for best service—the most for your money—they stay put. Contractors everywhere have approved Killark Fittings.

Complete stocks are maintained in Boston, New York, Philadelphia, Atlanta, Baltimore, Pittsburgh, Detroit, Chicago, St. Louis, Denver, Los Angeles, San Francisco, Portland, and Seattle.

## KILLARK *Explosion Proof* CONDUIT FITTINGS

For use in hazardous locations where explosive vapors are found. Eliminate dangers from explosions caused by short circuits and arcing switches. Made in a complete range of sizes and styles for every requirement. They are listed as standard by Underwriters' Laboratories for Class I Group D locations. Any combination of hubs can be furnished. Send for bulletin and complete information.



**KILLARK ELECTRIC MFG. CO.**

3910 EAGLE AVENUE

ST. LOUIS, MO.

An Item Important to Specify—and important to use



**IDEAL  
WIRE CONNECTORS**  
are available in these  
sizes:

Solid or Stranded Wires

No. 72—2 No. 18 to 3 No. 18.

No. 73—2 No. 18 to 2 No. 14 and 4 No. 16, 5 No. 18.

No. 74—1 No. 14 and 1 No. 18 to 2 No. 12 and 1 No. 18, 4 No. 14 and 1 No. 18.

No. 76—4 No. 14 or 2 No. 12 to 3 No. 10 and 1 No. 18, 6 No. 14 and 1 No. 18, 4 No. 12 and 1 No. 18.

### IDEAL SOLDERLESS AND SOLDER LUGS

One-piece quality construction. 24 sizes from 25 to 1050 ampere rating. Always in stock at factory.

**FULLY APPROVED. LISTED BY UNDERWRITERS' LABORATORIES**

*Write Today for Samples*

**IDEAL COMMUTATOR DRESSER CO.**  
1041 PARK AVENUE  
SYCAMORE, ILLINOIS

# IDEAL

## SOLDERLESS—TAPELESS WIRE CONNECTORS

*Save Time—Money—Speed Work*  
**EASY AS A-B-C**



The IDEAL Solderless-Tapeless Wire Connector threads into a conical-shaped copper coated steel spring insert; the insert thus becoming an additional current carrying conductor. The wires are compressed together in a vise-like grip—a permanent copper-to-copper contact.

### Used Exclusively Throughout Buildings Illustrated BECAUSE

- EASY to use—requires no solder and no tools.
- SAFE! No tape to dry out. Wires can't pierce through.
- CLEAN! No smudge or smoke.
- PERMANENT! No pulling apart.
- COMPACT! Fits into close quarters.
- ECONOMICAL! Lessens installation and maintenance costs.

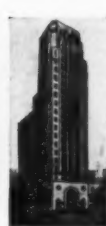
### AND IN THESE NEW BUILDINGS, TOO

Rockefeller Radio City, New York  
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Dept. of Commerce Bldg., Washington  
Internal Revenue Bldg., Washington  
Labor Building, Washington  
Carew Tower, Cincinnati  
Ford Motor Company Buildings  
Chevrolet Motor Company Buildings  
Cook County Nurses Home, Chicago  
Post Office, Detroit  
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### MILLIONS IN USE



A. W. National Bank Bldg., Baltimore, Md.



Central National Bank Bldg., Richmond, Va.



Fisher Bldg., Denver, Colo.



Philadelphia Federal Trust Bldg., Philadelphia, Pa.



The Lincoln Bldg., New York City



William Penn Hotel Addition, Pittsburgh, Pa.



The Philadelphia Hotel, Philadelphia, Pa.



Hotel Statler, Buffalo, N.Y.



The Empress Bldg., Pittsburgh, Pa.

### ARCHITECTS:

For permanency of electrical joints specify IDEAL Connectors—they make better electrical as well as stronger mechanical joints than solder and tape. Safety of joints is permanently increased since connections are enclosed in hard composition insulation. No piercing of tape or grounds as with a soldered connection.

### CONSULTING ENGINEERS:

First cost, maintenance cost and fire hazards are materially reduced by this compact, permanent connector for all electrical joints.

### ELECTRICAL CONTRACTORS:

Eliminate blow torch dangers, burning or scorching. Safer, quicker in application as well as safer in service. IDEAL Connectors speed work—reduce wiring costs—convenient to use.

# A three-minute plain talk with merchants who are not in business *"for their health"*

**YOU'RE** reading "Electrical Contracting"—which shows you keep your eyes peeled for smart ways to multiply your dollars.



## VISION—COURAGE—MERCHANDISE

For the first time in history, a manufacturer of lighting equipment has the *vision*, the *courage*, and the *merchandise*, to get behind his product with modern high efficiency promotion. Back of every Lightolier customer, today, is the same drive and action that have made tremendous profits for dealers selling electric refrigerators, radios, washing machines—but have never before been available in the field of residential lighting.

Now, with the biggest building boom in history under way, Lightolier invites contractor-dealers to make big profits from lighting equipment—without a cent of additional overhead: in fact, to use their *ceilings* and turn their "overhead" into profits!

### QUESTION FROM YOU:

"Well, Lightolier—what are you really doing?"

### ANSWERS BY US:

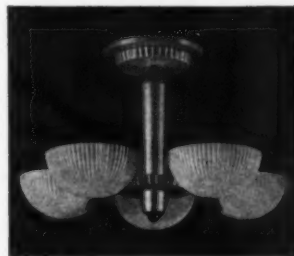
**1. NATIONAL ADVERTISING:** digging in deep, month after month, with generous space in a list of magazines read by a majority of the architects, decorators, home builders and home modernizers of America... nearly 8,000,000 per issue. Thousands of inquiries all handled in our customers' interests.

**2. "THE CHARM OF A WELL LIGHTED HOME"**—the most complete and alluring booklet ever given to a fixture-buying public. It will induce people to go to Lightolier dealers and say, "These are the fixtures I want."

**3. THE 1937 STYLE BOOK**—now ready—so full of new ideas in lighting that it is nothing short of "selling-dynamite". It offers a variety of choice for every type of architecture and every class of home, instead of aimless duplication that clogs ceilings and confuses customers. It is a line cleared for action and profits, meeting every demand of today's construction, and priced so you can't miss a sale you go after. But the Style Book goes **ONLY** to *Lightolier customers*—in line with our policy of *selective distribution*.

The contractor-dealer has always made real money selling lighting equipment. Don't let this profitable volume business get away from you now. Why shouldn't you, instead of the "other fellow", collect lighting fixture profits?

If you want to enjoy the profitable opportunities the Style Book offers, show us that you mean to use this book to our joint advantage. All you do is make a moderate investment and carry the catalog. We supply the instantaneous service and carry the fixtures. *Nobody carries the bag!* We repeat—the biggest building boom in history is now under way. Make it start earning for you. Get the details of the **LIGHTOLIER GUARANTEED PLAN**. Learn how little you need invest, how much and how quickly you can profit.



*Send us the coupon now*

## LIGHTOLIER

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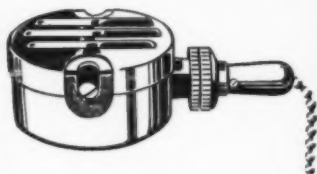
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Yes — tell me all about your Guaranteed Plan and how it will help me make money on lighting fixtures.

Name \_\_\_\_\_

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*Levolier***New Heavy Duty Switch**

Catalog No. 1010  
10 Amp. "T" 125 Volts  
5 Amp. 250 Volts

Save extra wiring expense by using the only 10 amp. canopy switch manufactured.

Controls 1000 watt Type C lamp from the canopy.

**McGill Mfg. Co.**

Valparaiso, Ind.

Est. 1904

Box No. 687

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**CRESCENT WALL GUARDS**

No. 1436



No. 1440

Genuinely high quality, long lasting guards for every purpose indoors and out. Easy to attach and remove. Cannot be knocked off. Wide variety of styles and sizes. Moderately priced. Write for Catalog No. 34 and prices.

**McGILL MFG. CO.**

Valparaiso, Ind.

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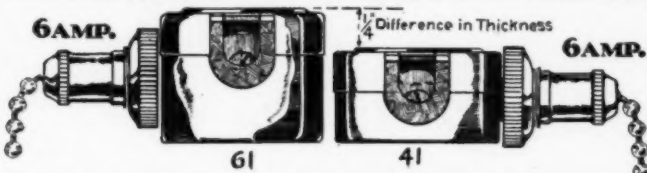
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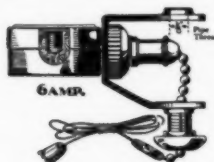
*Levolier*  
**SWITCHES**

(Approved by Underwriters)

For ease and economy of installation—for convenience of operation—for flexibility of usage—and for long, satisfactory service, LEVOLIER Switches know no equal. And no smaller six ampere pull switch is made. Standardize on LEVOLIER.



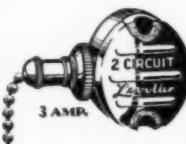
No. 61 Standard and No. 41 Thin LEVOLIER Switches, 6 Amp. Both No. 61 and 41 LEVOLIER Switches are easily and quickly installed. Exceptional load capacity. Three different stem lengths— $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{3}{8}$  inches.

**No. 38 LEVOLIER Switch Assembly, 6 Amp.**

Controls any ceiling fixture having a holding means in the center, if pan is  $1\frac{1}{2}$  inches deep in the center. No ceiling fixture is too deep. Fits any such installation having any number of lights up to 660 watts. Handles any length of chain up to and including 12 feet of No. 3, or its equal in weight.

**No. 39 LEVOLIER Link Switch, 6 Amp.**

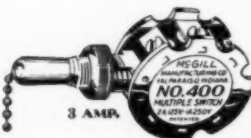
Quickly and easily substituted for any link desired to be removed from any fixture. No rewiring necessary. Switch withstands instantaneous overload when gas filled lamps are turned on.

**No. 201 LEVOLIER Two-Circuit Switch, 3 Amp.**

Used to operate the new three-light lamps. First pull lights smaller filament, second pull lights large filament, third pull lights both; fourth turns both off. 3 Amps, 125 Volts.

**No. 301 LEVOLIER Three-Way Switch, 3 Amp.**

Identical with No. 201 Switch in appearance, but is for use wherever three-way switches are used—to control one or more lights from two different points.

**No. 400 LEVOLIER Three-Speed Switch, 3 Amp.**

Designed particularly for installation in ventilating fans. Operates through a choke coil to give desired speeds.

*Write for Catalog No. 34***McGILL**  
**MANUFACTURING CO.***Electrical Specialties of Quality***ESTABLISHED 1904**  
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# P & S

originators of the  
**DESPARD**  
LINE OF WIRING  
DEVICES

*Brings these benefits  
to the Contractor*

① MOST COMPLETE INTERCHANGEABLE WIRING DEVICE LINE IN THE WORLD.

② LESS MATERIAL TO BUY AND CARRY.

③ OVER 60,000 COMBINATIONS FROM 22 DEVICES AND AN ASSORTMENT OF WALL PLATES.

④ MAKE ANY COMBINATION RIGHT ON THE JOB.

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⑥ A COMPLETE SERVICE IN ONE LINE.

⑦ A MODERN BUSINESS GETTER.

## THE OLD WAY



1 Six Gang Brass Plate..... \$1.87  
6 Single Pole Switches..... 1.98  
6 Switch Boxes..... .60

**COST \$4.45**

List Price

● One device to a box is wasteful of space.

## P & S THE DESPARD WAY



1 Two Gang P&S Despard Brass Plate \$ .45  
6 P&S Despard Single Pole Switches..... 1.98  
2 Switch Boxes..... .20

**COST \$2.63**

List Price

● The public is aware of the combination plate.

**EACH SUCCESSIVE P&S DEVELOPMENT HELPS YOUR BUSINESS**

*Here's your answer to*

### "WHAT IS AN ADEQUATE SPECIFICATION?"

Adequacy in wiring, you are told, will mean extra dollars for contractors.

But with the P&S Despard Line of Wiring Devices the contractor can make the word ADEQUACY look like the word SKIMPY.

From only 22 devices and an assortment of wall plates, over 60,000 combinations can be made.

Your own ingenuity and mechanical ability enables you to make a wiring job cover every conceivable need the owner has or wants to have . . . and the price will not scare away the business.

P&S Despard devices are not made for the "handy man around the house." Their installation can be done effectively only by the contractor's knowledge. They are distributed only through legitimate electrical channels. They keep the business in the electrical field where it belongs.

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 NEW ORLEANS, LA.—Southern Sellers, 918 Union St.  
 \*NEW YORK, N. Y.—H. H. Roberts & Co., 43 Warren St.  
 \*PHILADELPHIA, PA.—R. L. Cunningham, 600 S. Delaware Ave.  
 PITTSBURGH, PA.—H. W. Groetsinger, 15 E. Orchard Ave.  
 RICHMOND, VA.—L. W. Roberts, R.F.D. No. 6.  
 ST. LOUIS, MO.—R. H. Geiser, 1123 Washington Ave.  
 \*SAN FRANCISCO, CALIF.—Reeler, White Co., 1149 Howard St.

The Quad line of porcelain enameled reflectors includes Glassteel Diffusers, RLM standard dome and other standard shapes, as well as specialized equipment for flood-lighting and sign lighting.

The QD (Quick-Detachable) line provides general purpose reflectors equipped with removable and interchangeable socket fittings at somewhat lower prices.

Representative items of these lines are shown below and complete catalogs will be mailed from Chicago or any sales office on request.

In addition to the reflector types shown the Quadrangle line also includes porcelain enameled swivel stem pendants and ceiling holders with or without enclosing glassware.



## Glassteel Diffusers



Safety Type



Threaded Type

Made in two sizes for lamps up to 500 watts with opal and Trutint (daylight) glass.

## Heavy Threaded Reflectors



Threaded Socket-Hoods

RLM Dome shown includes sizes up to 1000 watts. Also made in Shallow Bowl, Deep Bowl and Angle shapes up to 500 watts.



Removable Reflectors

## RLM Standard Dome



Socket Type

for 1/2" or 3/4" pipe. Six sizes for lamps up to 1000 watts.



2 1/4" Fitter Type

for lamps up to 200 watts. Also made with shadeholders attached.

## Other Standard Shapes



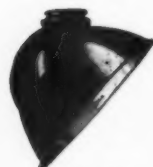
Shallow Bowl



Flat Cone



Deep Bowl



45° Angle

Each of the above styles is made in socket and fitter types and with shadeholders for brass, porcelain and W.P. threaded sockets. Socket Reflectors are tapped for 1/2" or 3/4" pipe and made for lamps up to 500 watts. 2 1/4" Fitter types for lamps up to 200 watts.

## Sign Lighting Reflectors



Spade—100 Watt



Rectangular Type H



Type H

Round Angle Reflectors



Type V

Round and Rectangular reflectors have QD interchangeable sockets to take lamps up to 500 and 1000 watts respectively. Both Spade and Rectangular reflectors provide straight line light cut-off at top of sign.

## Q-D Reflectors and Socket Fittings



Special Dome



Type B

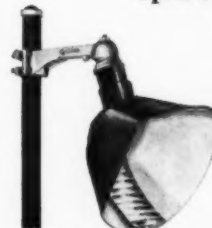
Socket Fitting for Outlet Box Mounting



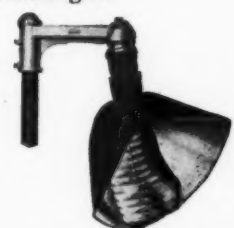
Shallow Bowl

Reflectors shown have Type "V" vertical fitting for 1/2" pipe which is interchangeable with type "B" (center) or Type "H" shown on sign reflectors above. The Special Dome is made in five sizes up to 500 watts and the Shallow Bowl in four sizes up to 200 watts.

## Open-Type Floodlights



With bracket for Open-Wiring—Can be mounted on 1 1/2" to 2 1/4" iron pipe, or on walls, wood poles or cross-arms.



With Bracket for Enclosed-Wiring—fits over end of 1 1/2" pipe or 2" if specified.

Floodlights have interchangeable auxiliary reflectors for beam control, note medium beam projector (left above) and long beam projector (right above). Lamp sizes range from 300 watts to 1500 watts. A triple bracket permits mounting in banks of three units.

# Marvelous LIGHTING IMPROVEMENT

WITH

## Sterling LITE-FLO REFLECTORS



Revolutionary **Sterling** Improvements in Reflector Design practically double the effectiveness of Show Window Lighting, using the same lamps and the same current.

This brilliant engineering achievement is accomplished through the New **Sterling** Lite-Flo Stipple and other design features. Light wasted by old style reflectors on the sidewalk and non-productive areas of the window is concentrated on the lower front of the window—the heart of the display—the spot that first meets the eye, and which must capture and hold attention.

The diagrams illustrate this improved distribution of light. The top diagram shows light wasted on sidewalks and also through intense illumination of the unimportant upper display window section with old style reflectors.

The lower diagram shows the intense **FRONT-LINE LIGHTING** accomplished by New **Sterling** Lite-Flo Reflectors that doubles effective illumination with the same lamps and the same current.

**Sterling** Engineers furnish complete technical information on Lite-Flo Reflectors and detailed plans for special applications without obligation.

### STERLING REFLECTORS Meet Every Requirement of—

- ☐ Show Window Lighting
- ☐ Display Case Lighting
- ☐ Refrigerator Lighting
- ☐ Floodlighting
- ☐ Interior and Exterior
- ☐ Cove Lighting
- ☐ General Interior Lighting

Complete catalog on request. Correspondence invited regarding any lighting problem.

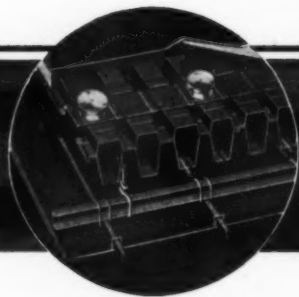


## REFLECTOR & ILLUMINATING CO.

1435 W. AUSTIN AVE., CHICAGO

*Learn the new*

**ELECTRICAL  
POSSIBILITIES  
of the Robertson  
Steel Floor Wiring  
System**



**E**NGINEERS and contractors who take advantage of the electrical possibilities of the Robertson Steel Floor Wiring System, find almost invariably that they give their customers a better job, and do much to forestall the electrical obsolescence which often proves so costly to building owners.

The Robertson Steel Floor, although primarily a structural member, can be advantageously adapted for the distribution of wiring. The floor is made up of parallel hollow steel cells . . . strong, light-weight . . . and each of these cells can serve as a protected wire raceway of generous capacity. Present and future electrical needs of any type of building can therefore be met by the Robertson System economically and more *safely*.



THE SAME FLOOR with the fill in place. This is one of four floors in a light manufacturing plant.

The Robertson Steel Floor Wiring System is a development you ought to investigate. Write us for free copies of our brochure "New Life for Buildings" and our special technical bulletin containing complete information. Do it *now*. Address H. H. Robertson Company, 2003 Grant Building, Pittsburgh, Pa.

● **ROBERTSON STEEL FLOOR WIRING SYSTEM**

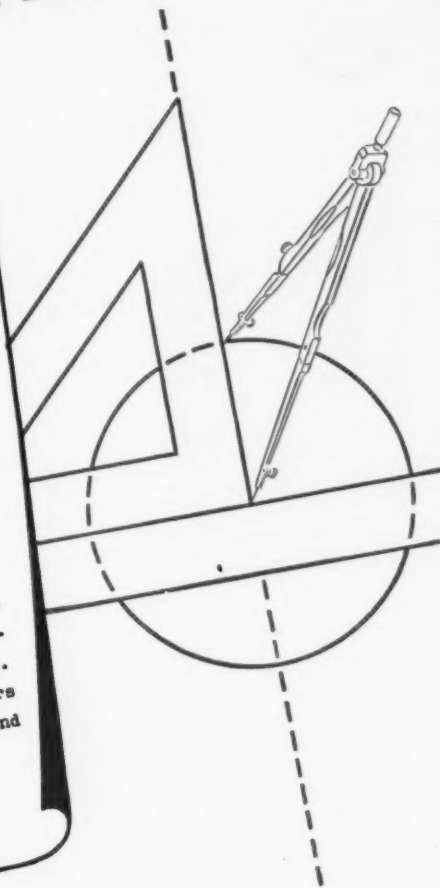


# This specification spells PROFITS

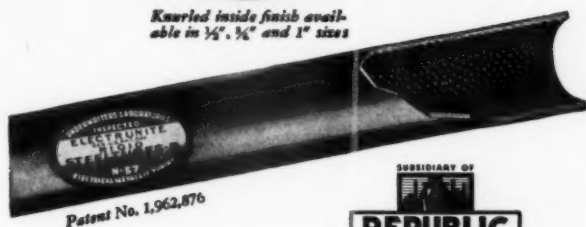
## SPECIFICATIONS

All electrical conductors shall be enclosed in ELECTRUNITE STEELTUBES Conduit, as manufactured by STEEL AND TUBES, INC., Cleveland, Ohio, sizes 1/2 in. to 2 in. inclusive. Tubing shall be made from S. A. E. 10-10 specification cold rolled open hearth strip steel, galvanized and manufactured in accordance with Underwriters' Laboratories Standards, and so labeled.

ELECTRUNITE STEELTUBES shall have electrically welded seams and shall be installed in accordance with the regulations of the National Electrical Code. Compression Couplings and box connectors shall be Underwriters' approved type and so listed.



Knurled inside finish available in 1/4", 3/8" and 1" sizes



Electrical specifications have two primary purposes: (1) Adequate, lasting protection to wiring and structure. (2) Economy in first cost and maintenance expense.

When the specifications say "ELECTRUNITE Steeltubes," there is never any uncertainty that both have been achieved. This electric resistance welded electrical metallic tubing provides adequate electrical and mechanical protection, and is fully approved for most every type of structure. It is resistant to corrosion and will last for the life of the building. And, with all fittings, it costs less than heavy-wall conduit.

In addition, "ELECTRUNITE Steeltubes" in the specifications means greater profits for you. It is easy to install...light in weight...easy to cut and bend...threadless...requires only 3 simple fittings...and the knurled inside finish makes wire pulling 30% easier.

Insist that electrical specifications include genuine "ELECTRUNITE Steeltubes"...and you'll install quality work at low cost...obtain more contracts and make greater profits. Write for further information.

Electrical Division

## Steel and Tubes Inc.

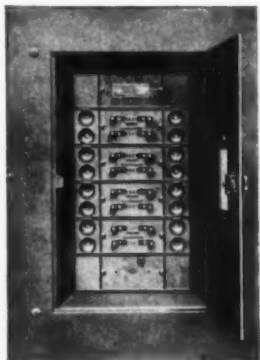
WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING  
CLEVELAND . . . OHIO

147

# WM. WURDACK ELECTRIC MFG. CO.

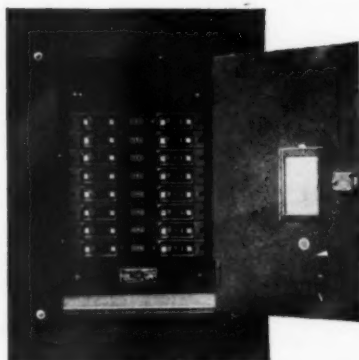


*General Office and Factory*  
4444 CLAYTON AVENUE, ST. LOUIS, MO.  
SALES OFFICES IN PRINCIPAL CITIES



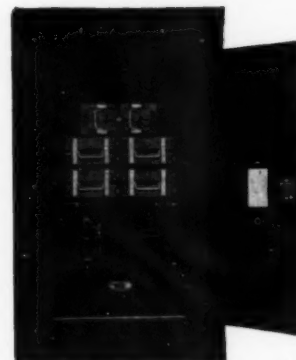
## WURDACK PANELBOARDS

A complete line of Dead Front Lighting Panelboards, constructed of standardized sections of moulded Bakelite. All switches and fuse receptacles are readily removable from front of panel. All Cabinets made of Code Gauge Galvanized Steel. Fronts of full finished cold rolled steel with black lacquered finish.



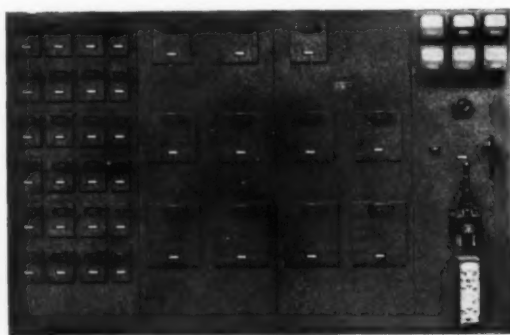
## CIRCUIT BREAKER PANELS

Are made in three general types. No. 1, For Branch Circuit Lighting. No. 2, Narrow Distribution Type. No. 3, Convertible Distribution Type. All panels are constructed with individually inclosed inverse time limit overload Thermal Circuit Breakers. Design of all panels is such that individual breakers may readily be removed from panel.



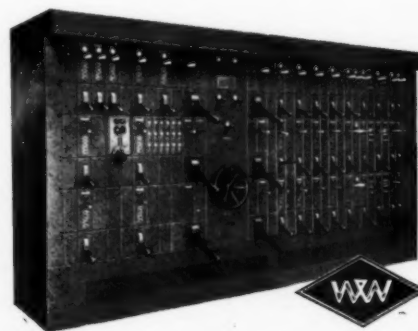
## DEAD FRONT FEEDER OR DISTRIBUTION PANELBOARDS

Are constructed of individual units of moulded Bakelite of the pull-out type up to 100 ampere inclusive. Circuits of 200 ampere and over are equipped with Auto Shift Switch Units. All units are convertible downward.



## WURDACK DEADFRONT SWITCHBOARDS

Of the Auto Shift Type are constructed of one-piece cold rolled steel panels with openings cut for individual Auto Shift Switch Units. These units are so constructed that all parts are dead when door is open. Fuses are mounted on insulated bases on back of steel inclosure eliminating all heavy parts from door.



## WURDACK REMOTE CONTROL STAGE SWITCHBOARDS

Are designed for all types of Theatres, Auditoriums, Fraternal Buildings and Schools where a modern system of lighting control is desired. Outstanding features are simplicity of design, convenience of arrangement and ruggedness of construction. Each installation is carefully engineered to meet its peculiar requirements.

# YOUNGSTOWN

## BUCKEYE CONDUIT

### ★HOT GALVANIZED

$\frac{1}{4}$ "  $\frac{3}{8}$ "  $\frac{1}{2}$ "  $\frac{3}{4}$ " 1"  $1\frac{1}{4}$ "  $1\frac{1}{2}$ " 2"  $2\frac{1}{2}$ " 3"  $3\frac{1}{2}$ " 4"  $4\frac{1}{2}$ " 5" 6"

The specially selected pipe for this conduit is first thoroughly cleaned by pickling and then immersed in a bath of molten pure zinc. After removal from this bath by a special process which leaves a clean, smooth coating of zinc on both the outside and inside of the pipe, the pipe is accurately threaded. A coating of tough transparent enamel is baked on both the outside and inside of the conduit, leaving a smooth raceway through which wires may be readily fished.

### ★ELECTRO GALVANIZED

$\frac{1}{4}$ "  $\frac{3}{8}$ "  $\frac{1}{2}$ "  $\frac{3}{4}$ " 1"  $1\frac{1}{4}$ "  $1\frac{1}{2}$ " 2"  $2\frac{1}{2}$ " 3"  $3\frac{1}{2}$ " 4"  $4\frac{1}{2}$ " 5" 6"

The pipe after being threaded, reamed and inspected is again thoroughly cleaned. The galvanizing equipment is so arranged that the pipe is uniformly coated on the exterior with zinc from one end to the other, and tests are continually made to insure proper weight of coating. A coat of baking enamel is then put on the interior, and the pipe is then sent to the baking ovens for finishing.

### ★BLACK ENAMELED

$\frac{1}{4}$ "  $\frac{3}{8}$ "  $\frac{1}{2}$ "  $\frac{3}{4}$ " 1"  $1\frac{1}{4}$ "  $1\frac{1}{2}$ " 2"  $2\frac{1}{2}$ " 3"  $3\frac{1}{2}$ " 4"  $4\frac{1}{2}$ " 5" 6"

After dipping, the conduit is allowed to set to insure uniform coating and prevent wrinkling. The loaded cages of pipe are then placed in baking ovens where an even temperature is maintained by pyrometers. The enamel is baked to a high lustrous finish, having a thorough tight coat with sufficient elasticity to guard against cracking in any bending or forming operation during installation.

### ★ELECTRICAL METALLIC TUBING

$\frac{1}{2}$ "  $\frac{3}{4}$ " 1"  $1\frac{1}{4}$ "  $1\frac{1}{2}$ " 2"

On the external surfaces is deposited a protective coating of pure zinc by the electro-galvanic process. This coating is uniform throughout and will withstand bending of the tubing without fracturing of the zinc coating. On the inside of the tubing there is baked a tough, elastic coating of enamel which not only forms a mirror-smooth raceway through which wires may be fished with ease but which serves as an efficient insulator for the wiring system. After the special zinc coating and the internal enamel have been applied the tubing is given a coating, both externally and internally, of transparent enamel which serves as an additional protection.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices

YOUNGSTOWN, OHIO

*Youngstown*



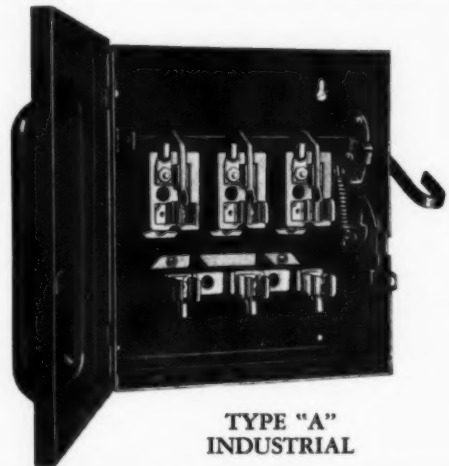
Tubular Products, Sheets, Plates, Tin Plate, Bars, Rods, Wire, Nails, Conduit, Unions, Tie Plates and Spikes.

# WADSWORTH

FOR MANY YEARS MANUFACTURERS

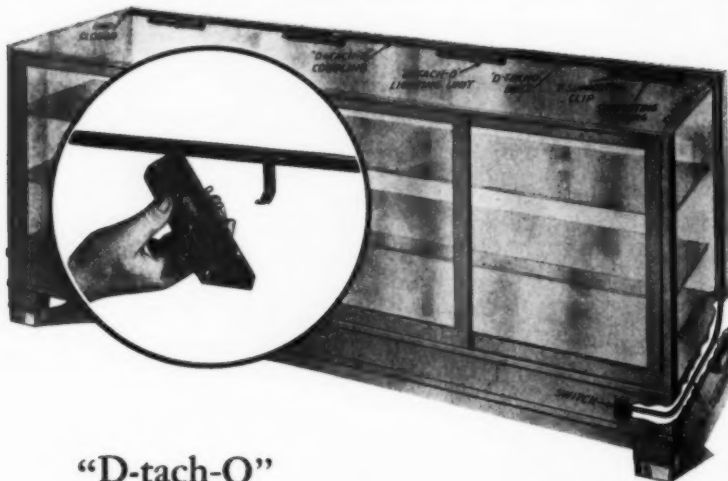
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Panelboards  
Branch Circuit Cabinets  
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TYPE "A"  
INDUSTRIAL

DEPENDABLE



"D-tach-O"

## Lighting Products for

Show Windows  
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Lighting Systems  
"D-tach-O"  
For All Types of  
Display Cases  
Bracket and  
Picture Lights

*The* WADSWORTH ELECTRIC MFG. CO. INC.  
Covington, Kentucky





Chanin Building Auto-  
matic Flood Lighting  
Control

**M**ORE than 250,000 Sauter Time Switches are now controlling switching programs in every section of the World. Their unrivaled performance is the result of simplicity of design and rigidity of construction—achieving longer service at lower costs. For their fine workmanship and performance Sauters are extensively specified by Utility Engineers.

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(\*) **SYNCHRONOUS MOTOR SWITCHES**, 2 to 40 amperes, 1-2-3 poles, single or double-throw.

(\*) **SELF WINDING SWITCHES, LOW CAPACITY A.C. or D.C.**, 2 to 15 amperes, 1 or 2 poles, single or double-throw.

(\*) **SELF WINDING SWITCHES, HIGH CAPACITY A.C. or D.C.**, 10 to 300 amperes, single or double-throw.

(\*) **SELF WINDING 4600 and 8000 Volt switches**, 25 and 50 amperes.

(\*) Plain or astronomic dials, indoor or outdoor cases optional.

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Time Switches

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## ADEQUATE WIRING

MEANS

ADEQUATE LUGS and CONNECTORS

"NO LIVE WIRE IS ANY BETTER  
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**K & H**

**LUGS AND CONNECTORS**  
ARE ADEQUATE FOR ALL WIRING



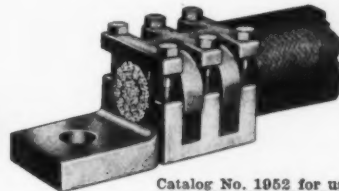
Catalog No. 1021 for use with wire  
sizes No. 8 to 4 inclusive.



Catalog No. 1015 for use with wire  
sizes No. 18 to and including No. 10.



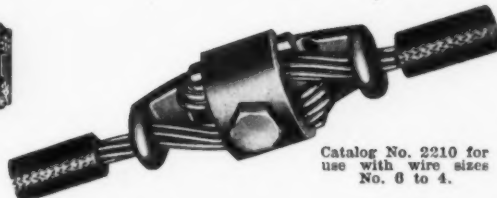
Catalog No. 401 for  
use with wire sizes  
1/0 to 2 million C.M.



Catalog No. 1952 for use  
with wire sizes No. 3 to  
2 million C.M.



Catalog No. 400T for  
use with wire sizes  
No. 6 to 2/0.



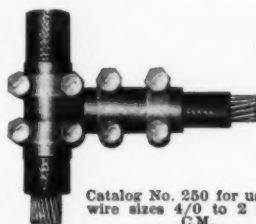
Catalog No. 2210 for  
use with wire sizes  
No. 6 to 4.



Catalog No. 1603  
for use with wire  
sizes No. 4 to 1  
million C.M.



Catalog No. 501 for  
use with wire sizes  
No. 1 to 3/0.



Catalog No. 250 for use with  
wire sizes 4/0 to 2 million  
C.M.



Catalog No. C.S. 106  
for wire sizes No. 6  
to 4/0.

WRITE FOR COMPLETE CATALOG

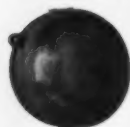
**KRUEGER & HUDEPOHL**

232-8 VINE STREET

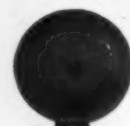
CINCINNATI, OHIO



Vibrating Bell



Monitor Type Bell



Single Stroke Bell



Buzzer



Kodekall



Chime



Megaphone Type  
Horn



Kodaire

# SIGNALS

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**F**OR boiler works and noisy machine shops there is the loud blare of the trumpet signal. For quiet hospitals and apartment buildings the pleasant chime. Within the wide range of Schwarze signals, you are certain to find the model to fit your particular requirement.

Small bells and buzzers, industrial bells and buzzers, horns of all sizes and types, including the newly developed Kodaire . . . chimes, sirens and the man-finding KodeKall each specifically designed to do a better job of signaling.

Schwarze signals have been manufactured since 1904. Thirty-two years of signal manufacturing experience qualifies us to give you the best.

Our engineering department and experimental laboratories are at your service. We invite you to use them to help you solve your signal problem.

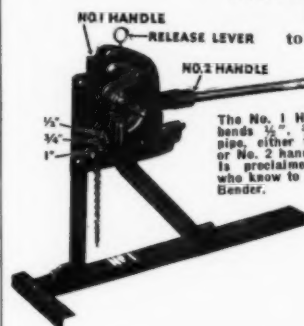
Our 1936 catalog is ready for distribution. Write Department E for your copy.

**SCHWARZE ELECTRIC COMPANY**  
ADRIAN MICHIGAN

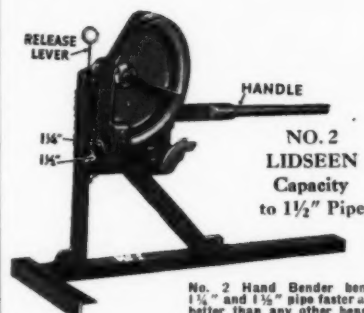
## A Pipe Bender for every PURPOSE!

These practical tools are built for every class of work, by men who know your requirements. They will make amazing savings in time and labor, bending your pipe uniformly and speedily. Write today for full details and take advantage of the savings these tools can make for you.

### NO. 1 LIDSEEN Capacity to 1" Pipe



The No. 1 Hand Bender bends pipe, either from No. 1 or No. 2 handle position. Is proclaimed by men who know to be the right Bender.



No. 2 Hand Bender bends 1 1/2" and 1 3/4" pipe faster and better than any other bender on the market today.



### NO. 4 LIDSEEN Capacity to 4 1/2" Pipe

The No. 4 Hydraulic Bender—for bending large size pipe up to 4 1/2". All Pipe Benders herein listed are bending pipe with as little distortion to pipe as is humanly possible.

G. LIDSEEN  
Inc.

832 So. Central  
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## LIDSEEN Pipe Bender

# QUALITY



# CONDUIT

## ELECTRICTUBE

Electrical Metallic Tubing is coated on the outside with zinc evenly deposited by electro-plating process to stand Preece test of more than four dips. Interior surface is coated with an enamel especially developed by us, which is impervious to acid and insures a perfect raceway for pulling wires. Can be used with any standard light wall fittings.

## GALVAKOTE

Exterior surface and threads coated with zinc evenly deposited by electro-plating process in quantity to withstand more than four dips of Preece test in regulation copper sulphate solution. Interior furnished coated with the best quality black enamel or with transparent enamel coating on both exterior and interior surface.

## ENAMELKOTE

Coated inside and outside with high-grade black enamel, properly baked in modern ovens to insure adhesion to pipe wall, and sufficient flexibility to prevent flaking in bending.

## HOTKOTE

Exterior and interior surfaces smoothly and evenly coated by hot galvanizing process. Coating will withstand more than six dips of Preece Test and is of a content of more than 1.25 oz. of zinc per sq. ft. of surface.

**CLAYTON MARK & CO.**

20 N. Wacker Drive, Chicago, U. S. A.

MANUFACTURERS FOR MORE THAN  
A QUARTER OF A CENTURY

# Specify SIMPLETS

*The fittings you will eventually use*

**Larger Wiring Space**

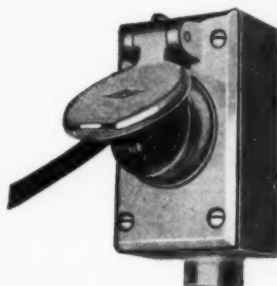


**Threaded Rectangular SIMPLETS—all types 1/2" to 4"**  
Malleable Iron — Cadmium Finish

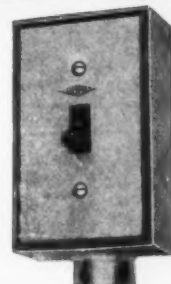
**No-Thread Rectangular SIMPLETS** for both rigid conduit and electrical metallic tubing—all types 1/2" to 2"



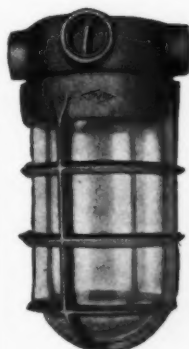
**"FS" SIMPLETS** with wide flat tops for vaportight mountings. All types in single, two, and three gangs.



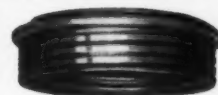
Square corners permit the use at any standard switch plate.



**Vaportight SIMPLETS** are most universal. Six simple types will take care of any possible installation, including adaptation to outlet boxes for concealed wiring.



The **SIMPLET 200-watt adapter** makes possible a change from 100 to 200-watt installations without disturbing wiring.



*Sold through jobbers*  
**Write for Catalog and Information**

**SIMPLET ELECTRIC CO.**

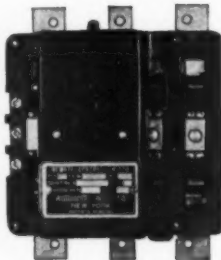
5100 Ravenswood Ave., Chicago, Ill.

Boston—22 Pittsburg St.  
New York—10 Jones St.

Los Angeles—912 E. Third St.  
San Francisco—1264 Folsom Ave.

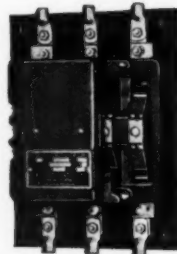


## A MODERN REMOTE CONTROL SWITCH FOR PANEL OR CABINET MOUNTING



Panelboard Mounting Type

### TYPE "RC"



Cabinet Mounting Type

A self-contained, compact, mechanically held, electrically operated switch—more easily mounted than any other type on panelboards and will fit in 4 1/2" boxes. It will operate in any position.

The "RC" Switch is free from A.C. hum and chatter because the single operating coil is momentarily energized.

Contacts are positively locked, closed or open, and can be operated manually if desired.

WRITE FOR BULLETIN 920

## Automatic Switch Co.

154 GRAND ST.

Founded 1888

NEW YORK, N. Y.

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CAST IRON - BRONZE & ALUMINUM

Established 1908



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No. 458

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Manufacturers of  
ELECTRICAL MATERIALS  
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Bar Hangers        Outlet Boxes  
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MIDWEST ELECTRIC MFG. CO.  
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**Profit Makers  
that help you  
get more Light-  
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### PORCELAIN ENAMELED REFLECTORS with SOCKETS

This standard dome reflector is made in five sizes and is a big seller for general illumination, indoors and outdoors.



### VAPORTIGHT FIXTURES

**N. E. C. Standard**

(Listed as Vaportight by Underwriters' Laboratories)

These units are made for use in oil fields, refineries, flour mills, grain elevators, engine rooms, and damp places where electrical connections and lamps must be protected from moisture or dust.

### ALZAK ALUMINUM OUTDOOR FLOOD LIGHTS

**Open Type for a wide variety of  
night lighting needs**



Alzak aluminum reflectors are finished with a diffused reflecting surface assuring lasting durability and high reflecting efficiency. They will not corrode and are easily cleaned. Outside finish is natural aluminum.

Go after more lighting business with OAMCO. Investigate this modern equipment now—write and let us give you complete details.

### OVERBACH AND AYRES MFG. CO.

411 S. Clinton St. Chicago, Ill.

## For AMPLIFIED SOUND EQUIPMENT

**Specify**



**CALL SYSTEMS:** For hospitals, institutions, factories, offices, restaurants, etc.

Specifications should include:

- Number of call points
- Approximate noise level
- Number of microphones
- Number of horns, if necessary
- Switching devices as required

### CENTRALIZED RADIO

**SYSTEMS:** For hotels, schools, institutions, hospitals, etc.

Specifications should include:

- Number of rooms
- Desired number of stations
- Whether ear-phones or speakers are necessary.
- Switching devices as required

### CENTRALIZED SCHOOL

**SYSTEMS:** For schools, colleges, academies, institutions, etc.

Specifications should include:

- Number of microphones necessary
- With or without radio
- With or without phonograph
- Number of classrooms to be equipped
- Size of auditorium
- Size of gymnasium
- Switching devices, as required

### PUBLIC ADDRESS

**SYSTEMS:** For arenas, stadiums, hotels, ball-rooms, night-clubs, restaurants, ships, convention halls, expositions, armories, etc.

Specifications should include:

- Number of microphones necessary
- Approximate area to be covered
- Approximate noise level
- Talking or music pick-up, or both
- Number of horns necessary
- Switching devices as required

Our engineering department will be glad to co-operate to the fullest extent laying out the necessary installations to conform with either your specifications or our recommendations.

**RADIO AMPLIFIER LABORATORIES**  
59 Walker Street, New York City

## TIME SWITCHES

**For Every Requirement**

For the past 27 years we have successfully concentrated on manufacturing highest quality time switches exclusively. Today we offer the result of our long experience in this highly specialized field.



### "BADGER"

**Synchronous  
Types**

This model is for operation on 60 or 50 cycle alternating current only. High capacity switch, accuracy in operation

and complete dependability are the outstanding features of these types.

All Types are Single Throw (Straight On and Off)

Type	Poles	Capacity Each Pole—125 V.	Case
M1	1	50 Amps.	16 Ga. Steel
M2	2	50 Amps.	16 Ga. Steel
RM	1	50 Amps.	Cast Iron
RM5	2	50 Amps.	Cast Iron



### "RELiance"

**8-Day  
Hand-Wound  
Types**

For operation on alternating or direct current and on any voltage up to 250. Furnished in both single throw and in plural circuit types. Can be obtained with open face (as illustrated) or closed face cast iron case. The two circuit types are most universally used for apartment house lighting.

Double Pole, Single Throw:

Type	Capacity—250 V.
10	10 Amperes or less
20	20 Amperes or less
30	30 Amperes or less
50	50 Amperes or less

Single Pole, Two and Three Circuit:

Type	Circuits	Sequence of Operations
A	2	No. 1 on—No. 2 on—Both off together
B	2	Both on together—No. 1 off—No. 2 off
C	2	No. 1 on—No. 2 on—No. 1 off—No. 2 off
D	3	No. 1 on—No. 2 on—No. 3 on—All off
E	2	No. 1 on—No. 1 off and No. 2 on—No. 2 off
F	2	No. 1 on—No. 1 off—No. 2 on—No. 2 off
G	2	No. 1 on—No. 2 on—No. 2 off—No. 1 off



### "RACINE"

**8-Day  
Hand-Wound  
Type**

Made in only one type, this model carries 10

amperes on any voltage up to 250, either A.C. or D.C. Case is of cast iron and supplied in closed face (solid door) only. Low in price, but high in quality.

Double Pole, Single Throw:

Type	Capacity—250 V.
1R	10 Amperes or less

Only the best of material and workmanship goes into these products and they are fully guaranteed against defects for one year from date of installation.

Write us for complete descriptive literature.

**RELiance AUTOMATIC LIGHTING CO.**

1937 Mead Street

Racine, Wis.



## Renewable Fuses



Performance records prove that TRICO FUSES tried under the toughest conditions give "Three Times The Service."

The non-interchangeable, tamper-proof, power-packed elements as used in TRICO FUSES make possible the superior service they give.

Accurate, safe and efficient protection is provided year after year because the casing is expressly designed to accommodate only the correct superior TRICO time-lag elements and not "foreign" links. For maximum fuse efficiency only the link designed for the particular brand of fuse should always be used.

### KLIPOK

Use KLIPOKS on old and new clips to eliminate destructive heating which causes no end of trouble and waste power. KLIPOK Clamps assure positive contact by extreme pressure on fuse clips.

Write for FREE Samples, Using Your Organization Letterhead.

TRICO FUSE MFG. CO., Dept. L, Milwaukee, Wisc.

Performance records prove that TRICO FUSES tried under the toughest conditions give "Three Times The Service."

The non-interchangeable, tamper-proof, power-packed elements as used in TRICO FUSES make possible the superior service they give.

Accurate, safe and efficient protection is provided year after year because the casing is expressly designed to accommodate only the correct superior TRICO time-lag elements and not "foreign" links. For maximum fuse efficiency only the link designed for the particular brand of fuse should always be used.

# MULTI



Industrial Fixture

Meet the demand for better and more efficient lighting by installing Multi enameled steel reflectors. They give full lighting efficiency—are rust-proof, and are easily cleaned. Ensure satisfaction by installing these long-lasting Multi enameled steel reflectors on all new and replacement work.



Two-Place Dome Reflector

The "MULTI" 2-place dome industrial fixture has a white diffusing glass globe with an all white reflector. The glass globe is held by a "MULTI" "Gripit" holder with internal finger support. No possible breakage from vibration or expansion.

Write for Complete Catalogue

**MULTI ELECTRICAL MFG. CO.**  
1840 W. 14th Street, Chicago

# REFLECTORS



## FLOODLIGHTS SPOTLIGHTS REFLECTORS



**Floodlights & Spotlights  
Outdoor—Indoor  
Show Window Reflectors  
Daylight Reflectors**

- Efficient illumination at minimum prices
- Hundreds of special Reflectors made from stock dies (10 to 1000 watt)
- Write for catalog

**ENDER MFG. CORP.**  
264 Canal St. New York

## The Last Word on Air-Recirculators




### The Kisco "DEFLECTO"

Cools without drafts and maintains a steady recirculation, far more effective than by any other method. It takes the cool air from the floor and recirculates it over a wide area, without disturbing the air at the ceiling.


New and basically different. Three models, three sizes; also with lighting feature. Attractively finished in black and polished aluminum. Sell them to large and small stores, homes, offices, hotels, and where quiet, effective air recirculation is desired.

**KISCO BOILER & ENGINEERING CO.**  
4333-35 Duncan Ave., St. Louis, Mo.

## For SAFETY—STRENGTH and SIMPLICITY, SPECIFY PIERCE RENEWABLE FUSES



Knife Blade Type  
Open



Cross Section  
Ferrule Type

Listed and labeled by  
Underwriters' Laboratories

**PIERCE RENEWABLE FUSES, INC.**  
238 FOURTH ST., BUFFALO, N. Y.

A connection in  
20 seconds with

### The MARR A Perfect Joint Connector

(CAP MADE OF BAKELITE)



**1** Twist or place the wires together in Connector and set down the screw. Then clip off protruding ends if any.



**2** Slip over the bakelite insulation. Screw it up tight and the job is done.

Marr Connectors are available in four sizes, to accommodate standard wire gauges. Also obtainable in porcelain. A free screwdriver adapted for each size is included with every carton of 100. WRITE FOR FREE SAMPLES TODAY. Approved by Underwriters Laboratories.

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NEW HAVEN, CONN., U. S. A.  
GENERAL SALES AGENTS 220 CHURCH STREET  
HATHEWAY AND COMPANY NEW YORK, N. Y., U. S. A.



### MASTER ANTENNA

★ Solves apartment house radio problem... one aerial for 25 sets.

★ Aerial kit, downlead cable, outlet units... simplicity itself.

★ For exposed wiring or concealed wiring... attractive outlets.

Ideal broadcast and short-wave reception... minimum noise.

★ Readily installed. Inexpensive. Guaranteed results. No comebacks. A nice profit.

**DATA:** Ask your local jobber or write us direct for technical and sales facts. Be the first in your town to do this profitable work!

**TACCO**  
**TECHNICAL APPLIANCE CORP.**  
17 EAST 16th ST. NEW YORK CITY

Current favorites  
everywhere



**USALITE**

Tested and inspected  
"SHO-BLO" FUSE  
PLUGS and wiring  
devices

For your customers' enjoyment of smooth uninterrupted electrical service specify the famous USALITE "SHO-BLO" self-indicating fuse plugs—the fuse that shows "O.K." when good and "N.G." when it blows—and the nationally known, high quality USALITE wiring devices—duplex receptacles, toggle switches, bakelite attachment plugs and other electrical and bakelite devices. They're current favorites everywhere.

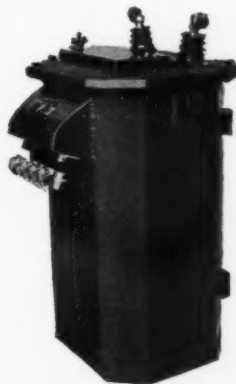
Send for further details and  
free samples today.

**UNITED STATES ELECTRIC MFG. CORP.**

222 West 14th St., New York, N. Y.  
Chicago—323 W. Polk Street



### UPTEGRAFF TRANSFORMERS



#### STUD-TYPE HD DISTRIBUTION TRANSFORMERS

For use in viaducts and  
basements where there  
may be moisture.

Write for bulletins.

**R. E. UPTEGRAFF  
MANUFACTURING CO.**  
300 North Lexington Ave.,  
PITTSBURGH, PA.

JUST PUBLISHED



### How to produce better neon signs

Told in this first adequate American book on the whole neon sign business.

## NEON SIGNS

Manufacture

Installation

Maintenance

By Samuel C. Miller, General Manager,  
Tube Light Engineering Company, and  
Donald G. Fink, Editorial Staff, Elec-  
tronics. 288 pages, 6x9, 105 illustra-  
tions...\$3.00

A complete manual of procedure and latest developments, showing step by step how neon signs work, what materials and equipment go into their manufacture, and how these materials and equipment affect the efficiency and life of the sign. Informs the experienced sign manufacturer on the best practice of other manufacturers, new methods of handling installation and maintenance, suggestions for producing better tubes, improving his equipment, getting new color effects and types of animation, etc. Up-to-date, detailed, practical. Chapter on Tricks of the Trade alone worth price of book.

#### Contents

The Neon Sign Industry.  
The Why and How of Sign Making.  
The Luminous Tube.  
Materials Used in Constructing Tubes.  
Electrical Equipment.  
Types of Signs.  
Shop Practice, From Specifications to Completed Sign.  
Designing the Sign.  
Glass Bending.  
Pumping Systems.  
Bombarding.  
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Tube-mounting Methods, Electric Wiring, Switching, Electric Testing.  
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# ELECTRICAL CONTRACTING

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S. B. WILLIAMS, Editor

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## *Intrastate Wages and Hours*

**A** GAIN, as in the decision that wiped out NRA, the Supreme Court in throwing out the Guffy Coal Law disclosed that the federal government has no power to fix wages, hours and commodity prices in intrastate commerce.

To the electrical construction industry this is of considerable significance because it would seem to definitely put an end to any revival of a wage and hour code for the industry.

There seems to be good reason for believing that the President if reelected will make plans for reviving NRA in some modified form. Since electrical construction is distinctly intrastate operation, it is hard to see how it can be affected.

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## *Farm Wiring Standards Needed*

**I**N arranging for the wiring for a model dairy farm near Washington, D. C. the Rural Electrification Administration realized how little is really known about the wiring of farmsteads. In the year that it has been operating R.E.A. has engaged in considerable study of adequate farm supply lines, but after the lines were projected it soon became apparent that the farmer was not taking full advantage of this service. In fact there was no one to tell him what constituted adequate farm wiring.

Some power companies have made suggestions with regard to farm wiring, but they are not complete and in some instances are not to be considered because of the experimental character of the wiring methods that are recommended. It is unfortunate, perhaps, that so many people are looking upon farm wiring as a cheap market for which something below urban standards must be devised.

There is an opportunity here for the electrical industry to cooperate with the R.E.A. in the establishment of some sound and practical standards for farm wiring. Unless the industry does initiate such a program, the farms will continue to be electrified with a minimum of wiring.

If inadequate wiring is a menace to cities, how much greater menace will it be on a farm where every man prides himself on his ability to fix anything? Inadequate wiring is an out-and-out invitation to the farmer to tamper with the wiring and the circuit protection when more lamps or appliances are purchased.

R.E.A. has emphasized the reduced fire hazard of electricity as compared with kerosene, but has it given proper consideration to the things that are necessary to make electricity safe? In the cities we have inspection, but except for a relatively few places, there is no inspection of farm wiring.

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## *A United Industry*

**A**FTER years of strong individualism riding rough shod over others who might get in the way, the four commercial branches of the electrical industry are now actively acknowledging their mutual interdependence. Under the leadership of the president of the National Electrical Contractors Association, a joint Industry Promotion Committee officially representing each of the four national associations is functioning for the entire industry. Locally similar committees are being set up to take national programs into their communities.

While founded upon market promotion, the full success of which is predicated upon teamwork, such joint industry committees offer the opportunity to promote good industry relations without which cooperation is impossible. Distrust goes out the door when good will enters. With good will, confidence and respect each for the other results. And when that happens we no longer look for the deficiencies in each other, but rather seeing each other's possibilities, we seek to make the most of them and thereby create opportunities of benefit to all.

So far only the contractors have stated their policy and what they will try to do to promote this united electrical industry. It may not be so easy for the manufacturers, wholesalers and utilities to state a policy as distinctly, but perhaps



they, too, sensing the benefits to be derived from industry cooperation, will soon state their position and thus give encouragement to those who want to believe but who are skeptical that the overtures may be all one sided.

We need a united industry today as we have never needed it before. Except for the rural areas the era of introducing service to existing premises is gone. New construction is coming back, but it is still small in comparison to what it was prior to the depression. Lowered rates have made it necessary for the utilities quickly to build up additional load. We must, therefore, tap new sources, new markets. We must intensively promote the use of electricity that those who are our customers will buy more. It is no longer a case of supplying a demand. We must now create a demand.

When all pull together in one direction, each helps the other and in the end all have profited. When each one is striving only for his own gain, the friction slows up all and in the end we have discord, mistrust, and low sales.

A united electrical industry has long been a hope of industry leaders. The eagerness with which this plan of Mr. Peak has been accepted gives encouragement to the thought that perhaps we are now ready for unified industry cooperation and that the present program will lead us happily to our markets.

### N.I.S.A.

**B**ORN of fear in the days of NRA code making, the National Industrial Service Association is now at the cross roads and must decide which of several paths to follow. The fear of being included under the electrical construction code with labor provisions that it considered fatal to its kind of business, no longer is a force to bind shop men together for mutual help and cooperation. Something else must take the place of that strong motivating force if widespread interest and enthusiasm is to prevail.

The entire service shop industry, counting only competent shops, is probably not more than three thousand strong. The possibilities for numerical membership is therefore greatly limited. Even if 25 per cent of the industry were members, it would amount to only 750.

Nevertheless, the industry has many problems. It is tasting the fruits of cooperation for the first

time in its existence and its leaders sense the good that can come out of it. As an industry it has been slow to progress because being local in character, its members, generally speaking, have had no opportunity to see what the other fellow was doing.

Each year, however, more motors are placed in operation and the opportunity for repair shops thereby increased. Is it any wonder then that competition has come in from the outside? A new competition based upon modern methods of production and management is making headway.

For the three years that N.I.S.A. has been in existence the work has been done by a small handful of enthusiasts. The dues are small but even so members are beginning to inquire as to what they are getting out of the association. What, they ask, has N.I.S.A. to offer us?

With a membership of approximately one hundred and fifty and dues from ten to fifteen dollars a year, how much can an association do? If the membership were doubled it would still have the same problem of insufficient revenue to do all of the jobs that are crying for attention.

The group needs field work not only for organization but for taking plans and ideas from one locality to another. It needs economic studies on machinery, mechanics, costs, methods, accounting. It needs the means to express itself as an industry to its suppliers and to its customers. It needs the means to develop standards, follow legislation, work out guarantee plans.

It can continue the way it is going with a few people doing all the work but if it does it will only be a short time before the organization disbands, because there will not be enough people of ability and at the same time the willingness to devote a large amount of time to working for the other fellow without pay.

To continue, N.I.S.A. must engage in more and more useful work and that means more money. There are two ways open. It can either raise the dues sufficiently to bring in enough revenue to do the job with its own organization, or it can affiliate with some other national organization like the N.E.C.A. and save the organization overhead.

Because the two organizations were apart during NRA is no reason for continuing to remain apart. There is room for them in N.E.C.A. as a section. They can make their own programs and lay out their own work. They can have all of the advantages of an independent association and at much less expense.

# There is no substitute for Confidence

**FLAME RETARDING . . .** Will not carry flame—prevents damage to braids and insulation during soldering or sweating into lugs.

**MOISTURE RESISTING . . .** Braids and insulation hermetically sealed, by a special process, against such destructive agents as moisture, light and air. Protected against condensation in conduits. Improves with age.

**FISHABLE . . .** Slick, patent-leather-like finish—with non-migrating lubricant dressing—does not become soft, gummy or tacky—easy to pull into conduits—more wires possible in a given size conduit.

**STRIPS CLEAN . . .** Saves installation time and labor—strips freely and cleanly.

**THERE IS NO SUBSTITUTE FOR SAFECOTE**

THE TRADE-MARKS OF THE MANUFACTURERS AUTHORIZED TO



ROEBLING  
SAFECOTE



The Austin  
THE H. S. AUSTIN  
COMPANY



SAFECOTE PERFORMANCE SPECIFICATIONS

GEORGE C. RICHARDS, LICENSOR'S AGENT



Permission to use the Safecote trade-mark carries with it the obligation to produce wires and cables in accordance with Safecote performance specifications.

ED TO MAKE AND SELL SAFECOTE ELECTRICAL CONDUCTORS



NSAVAILABLE UPON REQUEST

ENT 155 EAST 44th STREET, NEW YORK CITY

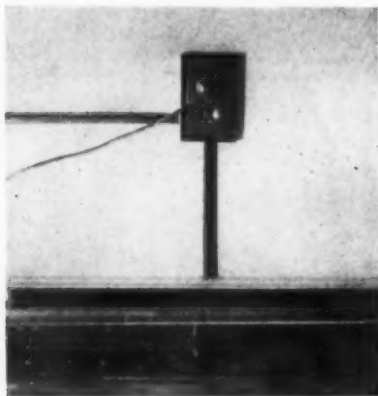


# Construction . .

## Methods . . . .

### Extension to Surface Plugging Raceway

The addition of "Plug-in-Strip" in a Cincinnati, O., office building was recently accomplished with very little disturbance to existing trim or plastered walls. The section of strip



was set against the upper edge of the wood base, and was finished off by a small piece of wood moulding set above the horizontal run of strip. This moulding was painted to match the wall. A standard metal raceway extension fitting was installed at the existing flush receptacle to permit extending surface metal raceway and supply wires down into the plugging strip.

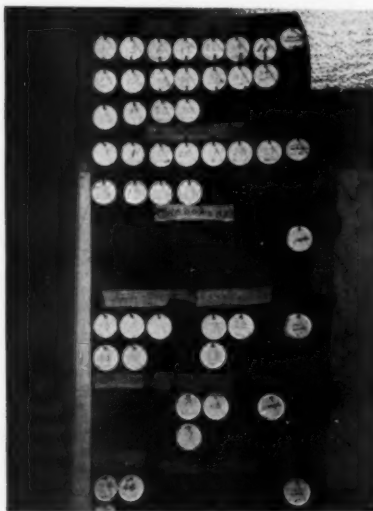
### Actual-Height Chart

Because electrical layout men are prone to jump at conclusions about the proper mounting height for various electrical outlets and control devices, the electrical engineering offices of Ray W. Chanaberry, Inc. at Louisville, Ky., have been stencilled beside door casings to show actual measurements from floor to ceiling. These measurements are marked off for each  $\frac{1}{2}$ -in., and a bold numeral appears alongside for each foot in height. Thus any off-hand mounting-height discussions with architects, owners or contrac-

tors can readily be "nipped in the bud" by reference to the standard chart, rather than have changes made on the job later on, because of hasty decisions at the start.

### Job Bulletin Board

With large crews of new men working back and forth between nine flood repair jobs, sometimes on five jobs per day, the D. R. Ross Electric Company of Pittsburgh, Pa., provided a bulletin-board in its temporary field office which avoided confusion. Each workman's name and an index number were printed on a set of metal-bound paper discs. Journeymen were assigned numbers from 1 to 50, while helpers were numbered above 50. The discs that were thus assigned to all employees were placed on pegs directly below



whatever job the men were working on. When a man was transferred to another job, his identification disc was also transferred to that section of the 13-in. peg board.

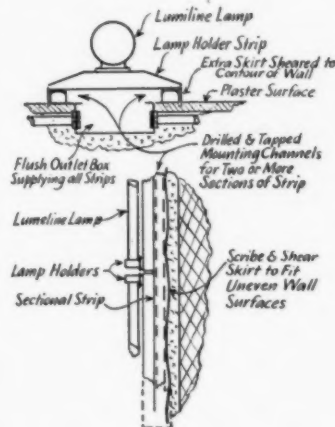
Much time was saved in keeping field records by writing up only the workman's number, rather than his name. Except for the master pay-

roll records, no other job records bore the names of workmen.

In addition to workmen discs, separate discs were also made up for each piece of construction equipment. The righthand peg of each job group was used for transferring tool record discs from one job to another. All tools not in use were pegged on the warehouse peg or field office peg. With this inexpensive method a positive record of men and tools on all jobs was easily maintained, although they were being transferred around many times each day.

### Fitting Lumiline Strip to Uneven Surfaces

With lumiline lighting effects becoming more widely used in commercial remodelling work, the application of unit lengths of lamp holder strip has been found troublesome with uneven wall surfaces. Where



two, three, and sometimes five or more 12-in. or 18-in. sections are installed, their unevenness is often quite conspicuous, and detracts from an otherwise novel line-lighting effect. A check-up among several recent installers of considerable quantities of lumiline strips in old buildings prompts a presentation of their recommendations for overcoming uneven mounting surfaces.

Pairs of common metal lather's channel iron are suggested as a backing or straightedge for two or more sections of strip. These lengths of iron should be continuous for the overall length of all strip sections comprising any unbroken horizontal or vertical line of light. The strips themselves should have an extra skirt or flange that would normally overlap and extend beyond the depth of the mounting channel webs. After the several sections of strip are mounted upon the channel irons, this

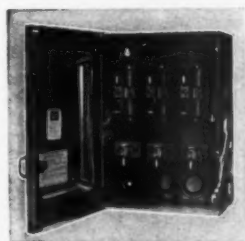


# We Build Colt-Noark Heavy Duty Switches just like they build battleships!

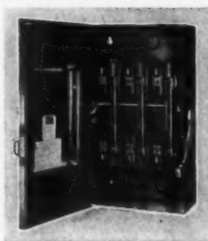


When you install a Heavy Duty Safety Switch, you expect it to take every type of punishment without a whimper—stand the gaff day in and day out. That's why Colt-Noark Type A Switches are built with extra ruggedness—extra strength—and with strong, efficient Quadbreak and Dualbreak mechanisms. When you specify Quadbreak or Dualbreak—you're getting more for your money than you get in any other switch!

## Quadbreak and Dualbreak Mechanism/ insure Strength-Efficiency-Long Life.



Colt-Noark Type A Switches in 250 Volt are Dualbreak as shown at left. In 575 Volt they are Quadbreak. Unit block construction—self wiping blades—roomy cabinets—plenty of knockouts—quick make and quick break—interlocking covers.



Colt-Noark Type A Weatherproof and Dust Tight Switches are Dualbreak. Rugged Cast Iron cabinets—interlocking covers securely fastened to cabinets by wing nuts—with rubber sealing gasket. 250 and 575 volts—fusible and non-fusible.



A new, complete Colt-Noark Catalog is now on our printer's presses. Full details on Safety Switches—Meter and Entrance Switches—Motor Starting Equipment—Fuses—Cast Iron Boxes.

Send for your copy. Ask for Catalog 59.

COLT'S PATENT FIRE ARMS MFG. CO., ELECTRICAL DIVISION HARTFORD, CONN.  
Boston, New York, Chicago and Philadelphia. H. B. Squires Co., Pacific Coast Representative



# COLT-NOARK

SWITCHES - MOTOR STARTERS - FUSES

100 Years of Manufacturing Experience  
is back of Every Colt  
Built Product

# YES! WIREMOLD DOES

FROM PANEL BOX TO OUTLET WIREMOLD MAKES REWIRING EASY

WIREMOLD WINDOW

WIREMOLD LUMILINE

WIREMOLD MULTI

## WIREMOLD LUMILINE LAMP STRIP

Makes it easy and simple to install any combination of 12" or 18" Lumiline Lamps—mounted end-to-end or singly as desired. The illustration shows Wiremold Duplex Lampholder Base No. 1127A or B for end-to-end mounting.

## STURDY WIREMOLD OUTLETS

Added as needed—  
Placed anywhere  
singly or in  
groups

No. 1042  
Duplex Receptacle  
Overhead wire  
multigrip connec-  
tion for desk lamps  
and appliances, etc.

# PANCAKE

"FLAT AS A PANCAKE!"

LISTED BY UNDERWRITERS LABORATORIES

# HELP CONTRACTORS!

AND OFFERS YOU MANY BUSINESS BOOSTING INNOVATIONS!

AND PANEL STRIP  
STRIP AND REFLECTOR  
PLUG-IN STRIP

## WIREMOLD DIRECTIONAL REFLECTOR

Provides an UNINTERRUPTED REFLECTING SURFACE, extending continuously to any distance. Illustration shows Wiremold Lampholder Base No. 1127 C—a single receptacle for use at end of run—together with 1110 B end fitting.

4" PLUG-IN STRIP IS EQUALLY SUITABLE FOR TELEPHONE CIRCUITS

"On the floor but  
not in the way!"

"HALFA HEEL HIGH"  
BUT PLENTY OF ROOM FOR  
4 No. 12 WIRES

# WIREMOLD

STRONG AS A BRIDGE!





Rajah can slip through chains but he can't slip through Slipknot Tape. It holds like grim death, with a rare combination of tensile and adhesive strength.

# SLIPKNOT TAPE

## P. R. SPLICING COMPOUND

### PLYMOUTH RUBBER COMPANY, INC.

*Largest Rubberizers of Cloth in the World*

CANTON

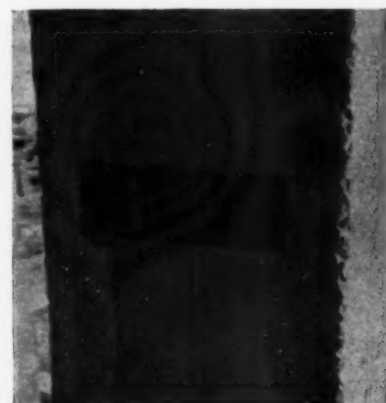
MASSACHUSETTS

assembly may be held on the uneven wall surface at its correct mounting position, while the contour of the surface is "scribed" around the outside "skirt," similar to the manner of a carpenter who scribes wood trim to trim it to fit uneven plaster at door or window casings. The surplus or extra projection of metal skirt would then need to be sheared off, leaving a "scalloped" or uneven edge which would fit firmly against all uneven wall surfaces, while the assembly of strips would present a perfectly even appearance.

Because only light channels are needed, they can be spaced at the outside edges of strip base, to allow clearance in the back for making wiring connections from flush outlets.

### Setting Ganged Switch Outlets in Concrete Columns

To get good results with outlets that must be installed in concrete columns, it is necessary to provide strong tie wires at several parts of larger boxes. This holds them tight



against the inner surface of the wooden column form and prevents the box from springing away or twisting out of alignment. Because of laborers tamping the poured concrete, with heavy objects; stresses and jolts to the several stubbed conduits; and often the movement of steel reinforcing bars after the boxes are made secure, it is necessary to make them as solid as possible, if a level and flush outlet, reasonably free of concrete grout, is to be expected. The illustration is a 5-gang switch outlet box in a concrete column at the Agnes Scott College job near Atlanta, Ga. Three sets of No. 12 iron wire were twisted through the back-of-box holes to the face of the column form, one set of wires at each end, and one set in the middle. The Peters Electric Company of Atlanta made the installation.



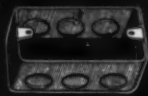
# HERE'S the COMPLETE BOX LINE



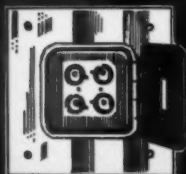
Concrete Boxes



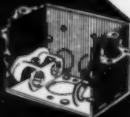
Outlet Boxes



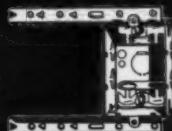
Utility Boxes



Fuse Cabs



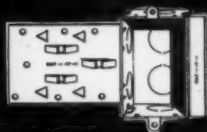
Sectional Boxes



Extended Ear Boxes



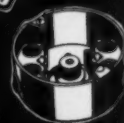
Jay-Kay Boxes



Bracket Switch Boxes



Bar-Sets



Ceiling Boxes

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Back of this great line stands the reliability of two famous trade-marks—the combined strength of the Roach-Appleton Manufacturing Co. and All-Steel-Equip Company, Inc. Quality of workmanship and materials has always been and always will be of paramount importance.

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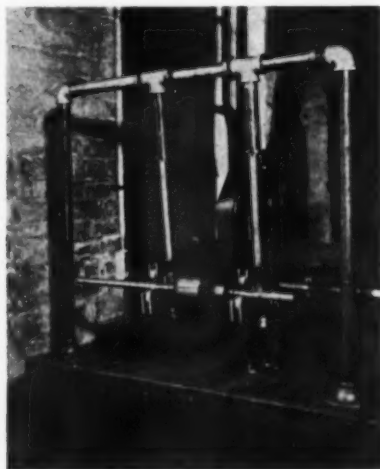


# Service Shop...

## Practice.....

### Belt-Rotated Balancing Stand

A bench-mounted trapeze type bearing rack for balancing small armatures or rotors, combined with a belt drive for quickly obtaining the desired speed of rotation has been designed by the Wm. C. Krauth Electric Company, Louisville, Ky. The rotor to be tested is put in motion



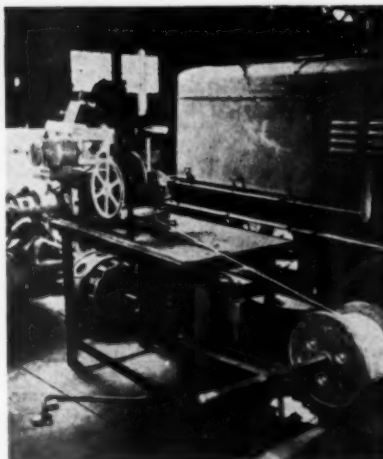
by pushing the pair of self-plumbing bearing stems or hangers forward until contact with the moving belt has imparted the desired speed. When the stems are released the rotor will swing back by gravity to a plumb position, and in the clear of the moving belt. It is, therefore, not necessary to stop the belt driving motor until a given balancing test has been completed.

The 20-in. wide, 33-in. high, 1-in. pipe frame is so spaced in front of the belt as to clear armatures or rotors up to 12 in. diameter. Shafts of not more than 31 in. overall length will clear the pipe uprights. The 2-in. leather belt passes from its upright pulley bracket through a slot in the bench to a  $\frac{1}{4}$  hp. 1,750 r.p.m. motor and 6-in. diam. pulley. Three sets of ball bearings and races are mounted edgewise between flat steel plates, which are in turn attached to  $\frac{1}{4}$ -in. square steel stems that fit into the self-plumbing pipe-

tee assembly on the balancing frame crossbar. The tees are machined out to slide smoothly upon the crossbar for widening or narrowing the points of bearing to suit various rotor lengths. Stop collars or keepers with thumb set screws are provided to align the swinging bearing bracket stems. The upper member of three ball bearings may be raised or lowered upon the square steel stem for locking in place with a thumb set screw, or removing the rotor. The pulley bracket was made from 1-in. angle iron, and supports two 2 $\frac{1}{2}$ -in. idler pulleys.

### Space Winder for Magnet Wire

To increase the air gap or spacing between layers of stock magnet wire in winding transformers, the Orlando (Fla.) Armature Works, Inc.,



made a self-feeding space winder which operates at the same speed at which the transformer winding head may be withdrawing magnet wire from the spool rack through this machine. As magnet wire is pulled through this machine it passes over several grooved pulleys, one of which is shafted to another series of pulleys and belts which in turn revolve a twine bobbin or spool around the

magnet wire as it passes toward the transformer winding machine. Spacer twine is thus applied automatically at a normal rate of two twine turns per linear inch of magnet wire. Several spare grooved pulley ratios are provided for varying the rate per inch of twine spacer turns. Two spools of twine are mounted upon the revolving spindle, one being a spare, to save replacement delays when a spool becomes empty. A small reel motor is mounted on the machine for winding twine upon these spools.

### Insulator Repair Depot

One of the special services that is performed by the Armature Winding Company, Charlotte, N. C., is rebuilding large insulators, transformer bushings and other similar equipment operated on 100 kv. lines. This view of the central part of the



shop shows the overhead track where large petticoat assemblies are suspended after new litharge has been placed between the insulators and properly sealed. Some of the large paper-insulated bushings, as in the foreground are baked for thirty days or more in a large oven to remove all moisture from them. Special 100 kv. testing facilities are provided for the work that is done in this department.

### Easy-to-Guide Dolly

Heavy motors can easily be moved around the shop at the Jacksonville (Fla.) Armature and Motor Works by means of a small two-wheel dolly that was recently built in the shop. Two 8-in. diam. rubber-clad wheels equipped with roller bearings were

# BULL DOG Vacu-Break

SAFETY SWITCHES

ARE  
*Doubly Safe -*

BECAUSE ALL ARCING IS

**DOUBLY SEALED**

With Switch Cabinet OPEN There Was  
**NO VISIBLE ARCING**  
When Rupturing Locked Rotor Current

FIRST—By the individual Arc Chambers—  
THEN—By the Enclosing Cabinet.



Above—a 200 Ampere, 3 pole VACU-BREAK Safety Switch connected to a 50 HP Induction Motor, ruptured the locked rotor current of 510 Amperes at 440 volts, 40% (lagging) power factor—without visible arcing.



ARC CHAMBERS of the VACU-BREAK switch are substantially air tight—not only minimizing arcing but also confining within themselves the little arcing which does occur. It was, therefore, possible to rupture the severe overload of a locked rotor with the switch cabinet OPEN without the least danger to the operator.

UNEQUALLED IN PERFORMANCE by reason of their unique circuit rupturing principle, VACU-BREAK Safety Switches—with their modern styled cabinets are also MATCHLESS IN APPEARANCE.

Close-up of VACU-BREAK Safety Switch with Cabinet OPEN, rupturing locked rotor circuit WITHOUT VISIBLE ARCING. Consequently with the Cabinet CLOSED (as normally operated) users of VACU-BREAK Safety Switches get the DOUBLE PROTECTION of TWO ENCLOSURES.



**BULL DOG ELECTRIC PRODUCTS CO.**

Manufacturers of Safety Switches, Fuses, Light and Power Panel Boards, Switchboards, Dist. Systems

**DETROIT, MICHIGAN**

Bull Dog Electric Products of Canada Ltd., Toronto, Ontario



# No Foolin!



## OHIO CARBON BRUSHES "BOOST" REFRIGERATOR MOTOR TORQUE

Perhaps the most important feature of refrigerator motors is their ability to maintain a high starting torque over a long period of time.

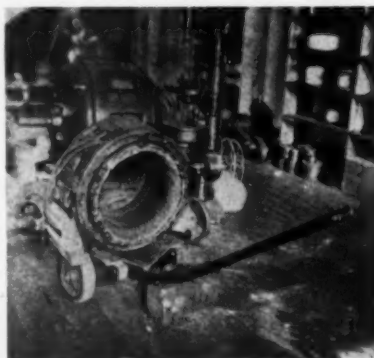
The brushes used on the repulsion-start motors commonly found in this service can help or hinder the maintenance of this characteristic depending on whether they keep the commutator in proper condition.

It would take too much space to explain what we mean by "proper condition" in an ad but if you'll call our bluff by writing in, we'll surely do it in a letter.

**For Assured Results Use  
Ohio PRE-TESTED Brushes**

**THE OHIO CARBON CO.**  
12508 BEREA RD. CLEVELAND, O.

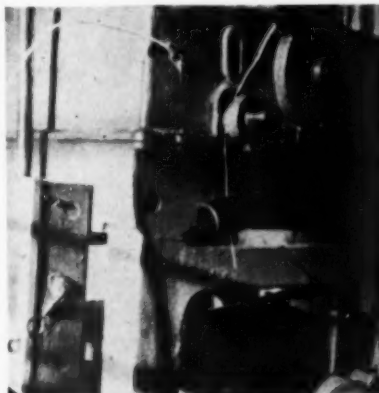
shafted to the under side of two 2-in. by 8-in. by 18-in. long timbers set edgewise. The upper edges of these timbers are tied together with a pair of 1-in. thick by 3 1/2-in. wide flat iron cross saddles. These cross saddles



were formed into a V-shaped pattern to clear the curved frames of motors. A 1-in. pipe handle with an iron T-bar was secured to the wheel shaft and welded to the forward cross saddle for rigidity. This outfit is easily loaded and guided, and one man has no difficulty in balancing heavy motors while moving them into the shop from the sidewalk, or to various parts of the shop.

### Keeper for Snipped-off Magnet Wire

When heavy loop coils are being wound by the Cleveland Electric Company, Atlanta, Ga., the operator sticks the snapped off



(spool) end of magnet wire into the barrel of a soldering lug that has been bolted to the case of the loop winder. After his wound loop has been removed from the head, his wire is within handy reach to begin winding another series of coils. Because of this handy-keeper, it is not necessary to bend a hooked end on the wire to hook it temporarily on the winder frame, nor to let it fall to the floor.

## For Satisfactory Profitable Repairs MICABOND

Industrial plants are a source of profitable, continuous and often extensive repair work. To handle such work satisfactorily and efficiently you need the best you can get in insulating materials. Micabond is Mica in its most usable form—widely adaptable—tape, paper, tubes, plate and other forms for all purposes. Samples are available on request. Write for them today.

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FIBRE COMPANY

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## RELIABLE SOLDERLESS LUGS

APPROVED BY  
UNDERWRITERS'  
LABORATORIES



INSURE  
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DEPENDABLE  
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ONE PIECE

WON'T VIBRATE LOOSE

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*For every application*



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Arc resistance and flash resistance.....	No. 672	Metal surfaces—coating.....	No. 650
Abrasion resistance.....	No. 335	Moisture and salt resistance—high.....	No. 7180
Armature coils—for flexibility.....	No. 327	Mining apparatus.....	No. 327
Armature coils—for oil resistance.....	No. 335	Mush wound stators.....	No. 327
Automotive armatures.....	No. 311	Packing plant motors.....	No. 327
Castings—protecting in weather.....	No. 410	Protecting metal surfaces.....	No. 650
Cementing and binding coils.....	No. 411	Porous materials—sealing.....	No. 1103
Coils—finishing.....	No. 414	Pipe threads—sealing.....	No. 672
Cement mill apparatus.....	No. 335	Railway armatures.....	No. 335 or 7180
Compressor motors.....	No. 335	Retouching apparatus in service.....	No. 414
Commutator vee rings.....	No. 672	Radio coils.....	No. 410
Collectors.....	No. 672	Smoothing and filling.....	No. 1103
Control boxes—interior.....	No. 672	Steel mill apparatus.....	No. 335
Electrical apparatus—finishing.....	No. 1133	Surface insulation—protection.....	No. 410
Field coils.....	No. 411 or gum	Speed drills.....	No. 411
Farm lighting coils.....	No. 335	Textile mill motors.....	No. 335
Fractional hp. motors.....	No. 335	Transformers.....	No. 311
Gasoline pump motors.....	No. 335	Vibration conditions.....	No. 327 or 411
High-speed armatures.....	No. 411	Weather proofing, Micarta, wood, fibre.....	No. 410
Household motors.....	No. 335	Wound apparatus—finishing.....	No. 410 or 414
High temperature—steel mills.....	No. 335	Wound apparatus—treating.....	No. 311
Industrial—general.....	No. 335	Windings subjected to vibration.....	No. 327 or 411
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# Westinghouse



Varnishes  
Cements, Compounds  
Treated and Untreated Fabrics  
and Papers, Mica

*These  
Fins Dissipate  
Heat*

... JUST AS THE "DE-ION"  
QUENCHER DISSIPATES ARC  
HEAT AND ADDS LONG LIFE  
TO THE

*New* **WESTINGHOUSE  
LINESTARTER** ....



**J**UST as the fins on an air-cooled motor dissipate heat, so does the "De-ion" Arc Quencher on a Westinghouse Linestarter cool the arc and extinguish it instantly. This means unusually long contact life. It cuts maintenance costs to the vanishing point, making new Westinghouse Linestarters a profitable investment for replacing obsolete equipment.

Application of the famous "De-ion" principle to Linestarters is the most important advance in motor starter design in years. Only Westinghouse gives you its numerous advantages.

For complete details, write or call your local:  
**WESTINGHOUSE OFFICE**      **WESTINGHOUSE JOBBER**  
**WESTINGHOUSE INDUSTRIAL AGENT**

**SUPER-SAFETY**—No flash or flame—the arc is snuffed out instantly by the "De-ion" Arc Quencher. This means elimination of flashover, assuring safety for operators.

**COMPACT DESIGN**—Banishing of arc hazard by the "De-ion" quencher permits a snugly-built, compact mechanism retaining ample wiring space and complete accessibility of all parts for quick installation or inspection.

**RELIABILITY**—The "De-ion" arc quencher confines, divides and extinguishes the arc without the usual flash and flame—insuring freedom from flash-overs, high overload capacity and dependable, trouble-free operation.

J 20040

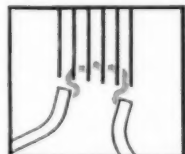
## HOW IT WORKS

In the past, arcs have been broken by "stretching." The "De-ion" arc quencher confines, divides and extinguishes arcs instantly—obviously preventing concentration of intense burning heat on contacts or arc barriers.

THE OLD WAY



THE "DE-ION" WAY



# Westinghouse

**"DE-ION" LINESTARTERS •**

# USE THE NOFUZE CIRCUIT BREAKER *as a wedge to* THREE WAY SALES



- 1 NOFUZE BREAKER ORDERS
- 2 NEW WIRING JOBS
- 3 MAINTENANCE CONTRACTS

Westinghouse Nofuze Circuit Breakers economically replace fused equipment—in addition providing complete safety for operators and positive, permanent protection for electrical circuits, with *nothing to replace*... no delays in restoring service. Available in ratings from 15 to 600 amperes at 125 to 250 volts d-c., or 115 to 600 volts a-c.

Fuseless circuit protection has definitely proved an effective opening wedge to three sources of profitable business. First, the circuit breaker itself is a profitable item—but that's only the beginning. Sell breakers and you've also sold a profitable re-wiring job. And we have cases on record where the resultant **SAFETY** and **SAVINGS** brought permanent contracts for plant electrical maintenance.

For full details on the complete line of Westinghouse Nofuze Circuit Breakers, and **PROOF** that they save money, call or write your nearest Westinghouse Electrical Jobber today.

J 20064

**BID**  
"All Westinghouse"  
FOR UNDIVIDED  
RESPONSIBILITY



## Westinghouse

Draw on this complete line, perfected by 50 years of electrical experience... backed by a mighty name.



**DC (D-C.) MOTORS**  
—Industry's most popular general purpose direct-current motor.



**NEW "DE-ION" LINESTARTERS**  
—Most important forward step in entire history of motor control equipment.



**"DE-ION" SAFETY SWITCHES** — Of every size and type, with exclusive "De-Ion" arc quenchers.



**CS (A-C.) MOTORS**  
for any constant-speed drive—all sizes and types from 1 hp. up.

# Lighting . . . . .

## Data . . . . .

### Lighting Recommendations for Summer Sports

By J. A. Summers and Dean M. Warren

General Electric Co.,  
Nela Park Engineering Dept.,  
Cleveland, Ohio

**I**N PLANNING a lighting system for outdoor recreational areas, there are four basic principles that should be given initial consideration. They are as follows:

1. Give consideration to type of audience. A large audience requires more light than a small one in order to hold their attention.

2. When lighting games in which only the players are considered, provide more light for skillful ones than less skillful. This is necessary because the skillful player has to see in greater detail all operations of game.

3. Absence of glare is absolutely essential. Players cannot do their best when being continually blinded and audiences should be protected from objectionable spill.

4. Outdoor lighting installations should not be flimsy. Equipment should be sturdy enough to withstand high winds.

#### General Recommendations

**Archery**—Ten footcandles recommended on target. Use a 250-watt lamp in a narrow beam projector and mount unit 10 ft. high and directly behind archer. Only one projector is needed for each target.

**Baseball**—Fifty footcandles recommended on infield and 30 f.c. on outfield. If enclosed type projectors are used these should be equipped with 1,000- to 1,500-watt lamps and mounted on towers 90 ft. high. Six towers are used and located as shown on the sketch. Enclosed type projectors should be of narrow beam type, and equipped with visors.

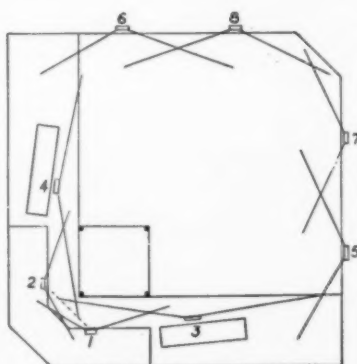
If open type reflectors are used,

units may be mounted 70 ft. high. Same spacing and lamping as recommended for enclosed projectors satisfactory except that one more tower is needed on each side of the field. These towers are designated as 7 and 8 on the sketch.

**Badminton**—Twenty-five footcandles recommended. Large mat enamel open reflectors equipped with either 750- or 1,000-watt inside frosted lamps are recommended. The units should be mounted 25 ft. high and placed at the ends of the net just outside the court.

**Bathing Beaches**—One-half to one footcandle recommended. Banks of narrow beam floodlighting projectors equipped with 1,000-watt inside frosted lamps may be located on 30-ft. poles at least 50 ft. back of the high-water mark. The spacing between the groups of floodlighting units should not exceed 400 ft.

For small resort beaches it is often possible to light them by means of floodlights located on convenient trees. This method is per-

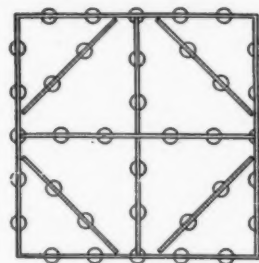


Baseball

fectly satisfactory if the branches which would ordinarily intercept the light are sufficiently high to permit the proper mounting.

**Toboggan slides** are found on many beaches. These are lighted by placing 1,000-watt open floodlight about 15 ft. above top of slide near back and directing light down the slide. Where steps leading up to platform are at rear, they can be lighted by a 200-watt lamp in RLM Dome reflector. Unit may be mounted on same pole as floodlight.

**Boxing**—One hundred footcandles recommended for average bouts. Two hundred to five hundred footcandles recommended for profes-



Boxing

sional and championship matches. Sixteen units of the concentrating type equipped with 1,000-watt lamps and mounted 18 ft. above the ring will prove satisfactory for average bouts.

For championship matches where crowds are large and movies are generally taken for newsreel, 36 units are recommended. These units should be spaced as shown in sketch.

**Bowling on the Green**—Six footcandles recommended. Sport usually played on area 126 ft. square. Either side, or overhead lighting satisfactory. Former accomplished by equipping elliptical angle reflectors with 750-watt lamps and mounting them 20 ft. high. Twelve units are used, three on each of four sides. Units spaced 42 ft. apart and 21 ft. from end. Rows should be approximately 5 ft. outside of court line.

Overhead lighting accomplished by locating RLM Dome units equipped with 500-watt lamps on messenger cable 25 ft. above the playing area and spacing them 25 ft. apart.

**Croquet**—Six footcandles recommended. Sport usually played on area 30 ft. wide by 60 ft. long. Either side or overhead lighting



satisfactory. For side lighting use open type angle reflectors and equip with 500-watt lamps. Mount units on 16-ft. poles and space poles 12 ft. from end of court and 36 ft. apart. For overhead lighting use RLM Dome reflectors on messenger cable. Equip units with 300-watt lamps, mount them 25 ft. high and space them 15 ft. apart.

**Golf Driving Ranges**—Two types of units necessary, a medium angle projector and a narrow angle projector. Former, equipped with 1,000-watt PS-52 bulb lamps used to light short high shot and latter equipped with 1,000-watt G-40 bulb lamps to light the long drive.

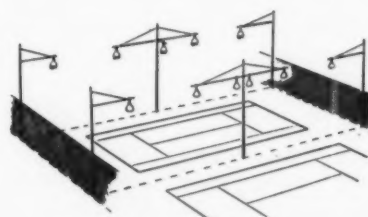
**Horseshoe Courts**—Ten footcandles recommended. Where there are one to three courts, use two elliptical angle reflectors, equipped with 200-watt lamps and place them on 20-ft. poles 6 ft. from pitching line and midway between pits.

Where more than three courts are to be lighted, use proportionally larger units in the same relative location or place one RLM Dome reflector, equipped with a 300-watt lamp, on pole 20 ft. high and located half-way between pitching lines and midway between pits of two adjacent courts.

**School Playgrounds**—Five footcandles recommended. In general, satisfactory illumination can be produced for small playground by locating six open type reflectors equipped with 1,000-watt lamps on school buildings adjacent to the playground. Lighting should come from at least two directions. Mounting height should be at least 40 ft.

**Park Playgrounds**—Five footcandles recommended. As these playgrounds cover a much larger area than school playgrounds, a projector which will enable better control of light, and which will project it a greater distance, is required. Four to eight locations are required with two to four projectors at each location.

If softball, basketball, etc., are



Tennis

played, special treatment is required.

**Race Tracks**—Six footcandles recommended. Lighting accomplished by locating RLM Dome reflectors equipped with 1,500-watt lamps on 30-ft. poles equipped with 16-ft. mast arms. Poles should be placed on inside of track. On the home stretch, two rows of units should be used, one on inside and other on outside of track. On curves and backstretch, two units per mast arm are necessary. The units are placed 4 ft. and 16 ft. out from pole and equipped with 750-watt lamps. To silhouette horses so that they are easily visible from grandstand, place white canvas for background. Flood lighting projectors may be placed on grandstand to light the track in front.

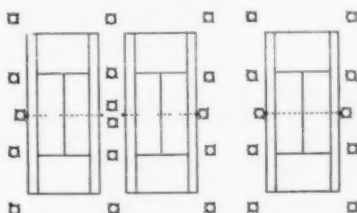
**Skeet**—Use medium angle projectors with 40-deg. spread lens and equip them with 1,000-watt lamps. Mount units 20 ft. high in banks of five. First bank should be located between second and third shooting places and second bank between fifth and sixth. Banks should be located 30 ft. back of shooting line.

**Swimming Pools**—Three different methods of lighting may be used.

1. For large pools locate two 1,000-watt floodlighting projectors on each of four poles as illustrated and place poles at four corners of pool far enough away from edge so that glass from broken bulbs will not fall in water. Poles should be 25 to 40 ft. high. Direct projectors so as to distribute the light evenly over the surface of the water.

2. For medium size pools use RLM Dome reflectors equipped with 750- or 1,000-watt lamps. Suspend reflectors 20 ft. above pool on messenger cable and space them 30 ft. apart.

3. If pools are clear, underwater lighting may be used. Either dry niche or wet niche method, as illus-



DOUBLE TENNIS COURTS

SINGLE TENNIS COURT

# SHAWMUT SHUR-LAG RENEWABLE FUSES



- ★ After blowing, fragments of link can be quickly, easily removed.
- ★ Knife Blade Type have no small parts to become lost or mislaid in refilling . . . simple and efficient in design.
- ★ Permanent rigid blade alignment . . . Blades are assembled to an extra heavy insulating crossbar.
- ★ Can be assembled ONLY one way . . . the correct way.
- ★ Shawmut Shur-Lag Renewable Fuses are sturdily built and provide greater time lag under unusual overload conditions.
- ★ Ferrule Type permit speedy renewal . . . plenty of room to insert link in fuse case . . . Ferrules have deep screw driver slots.
- ★ Links are of uniform thickness . . . can be inserted from either end of fuse case.

UND. LAB. APPROV.

Send for Shur-Lag Folder. It contains prices, etc.

THE CHASE-SHAWMUT CO.

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Fuse Specialists Since 1893



**FOR....permanence  
beauty • low  
cost • efficiency**

**for....SIGHT  
SAVING**

**specify....SIGHT  
CRAFT**

## **SIGHT-CRAFT specifications insure BETTER LIGHTING**

### **INDIRECT LUMINAIRES (as illustrated above)**

Reflectors shall be so shaped that the greatest candle power shall emanate at an angle of not less than 25 degrees from the canopy and shall gradually decrease between the point of greatest intensity and the canopy . . . The reflector and socket cover shall be made of highest grade enameling iron and finished with three coats of vitreous enamel (VITROLUX). Each coat shall be fired on separately at a temperature of not less than 1400 degrees F. The exterior finish shall be a neutral ivory with black beaded chip proofed edges. The interior, or reflecting surface of the reflectors shall be a smooth white, free from blemishes, and having a reflection value of not less than 70% . . . The socket covers shall be of sufficient length to cover the neck of the lamp and the space between the levels of the bottom of the socket cover and the upper edge of the reflector shall not exceed 1/2 inch . . . The reflector shall be supported from the socket cover by three supporting members hooked into loops which have been welded to the interior of the reflector before enameling. The assembly shall be such as to permit cleaning and relamping without the necessity of removing the reflector from the fixture . . . Sockets shall be secured to socket covers by two screws to prevent turning . . . Where stem hangers are used the hanger shall be equipped with a self aligning ball joint at the canopy.

### **INDUSTRIAL REFLECTORS (as illustrated at right)**

Reflectors shall be made of highest grade enameling iron and finished with three coats of vitreous enamel (VITROLUX), each coat fired on separately at a temperature of not less than 1400 degrees F. The interior finish, or reflecting coat, to be a smooth white, free from blemishes and with a reflection value of not less than 70%. The gauge of metal used shall be of sufficient thickness to insure a good serviceable product which will withstand all ordinary handling without losing shape or cracking of the enamel.

**WRITE FOR COMPLETE CATALOG—ELC 636**



**SAN FRANCISCO**  
154 Eighth Street

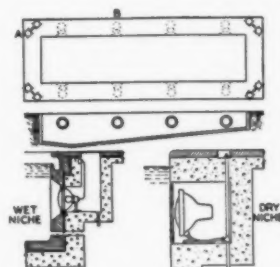
# **SMOOT-HOLMAN COMPANY**

**INGLEWOOD, CALIFORNIA**  
**NEW YORK** 10 JONES STREET  
**SEATTLE** 532 First Ave. So.



trated, is satisfactory. Former consists of locating 500-watt projectors with 40-deg. spread lenses 12 ft. apart on each side of pool and providing a manhole for servicing. Latter is same except that underwater equipment is necessary. Units should be mounted 1 ft. to 1 1/2 ft. below water level and protected by bull mesh. Easily accomplished if pool can be drained.

If cost permits, use either dry or wet niche method for existing pools. If economy is necessary,



**Swimming pool niches**

use water-tight underwater floodlight projectors. Equip them with 250-watt lamps and place them 10 ft. apart on either side of pool. However, not being flush with wall they sometimes interfere with swimmers.

**Tennis Courts**—Twenty-five to fifty footcandles recommended. Lighting accomplished by locating five deep bowl aluminum reflectors with skirts on each side of court, as illustrated, and equipping them with 1,500-watt lamps. Units should be mounted at least 30 ft. high.

For lighting two or more courts use five units with skirts on outside edges of end courts and six units without skirts on rows between courts, as shown. Mount units 30 ft. high and equip them with 1,500-watt clear lamps.

**Trap Shooting**—Eight medium beam floodlighting projectors equipped with 1,000-watt lamps are recommended. Use two per pole and place poles behind and to either side of the shooting platform. The beams from each station are crossed to eliminate shadows. Stray light on platform enough to sight guns.

**Volley Ball**—Fifteen footcandles recommended. Lighting accomplished by locating six oxidized aluminum angle reflectors, equipped with 1,000- or 1,500-watt lamps on 30-ft. poles and locating poles, three on a side, 7 ft. from sides of court and 30 ft. apart.

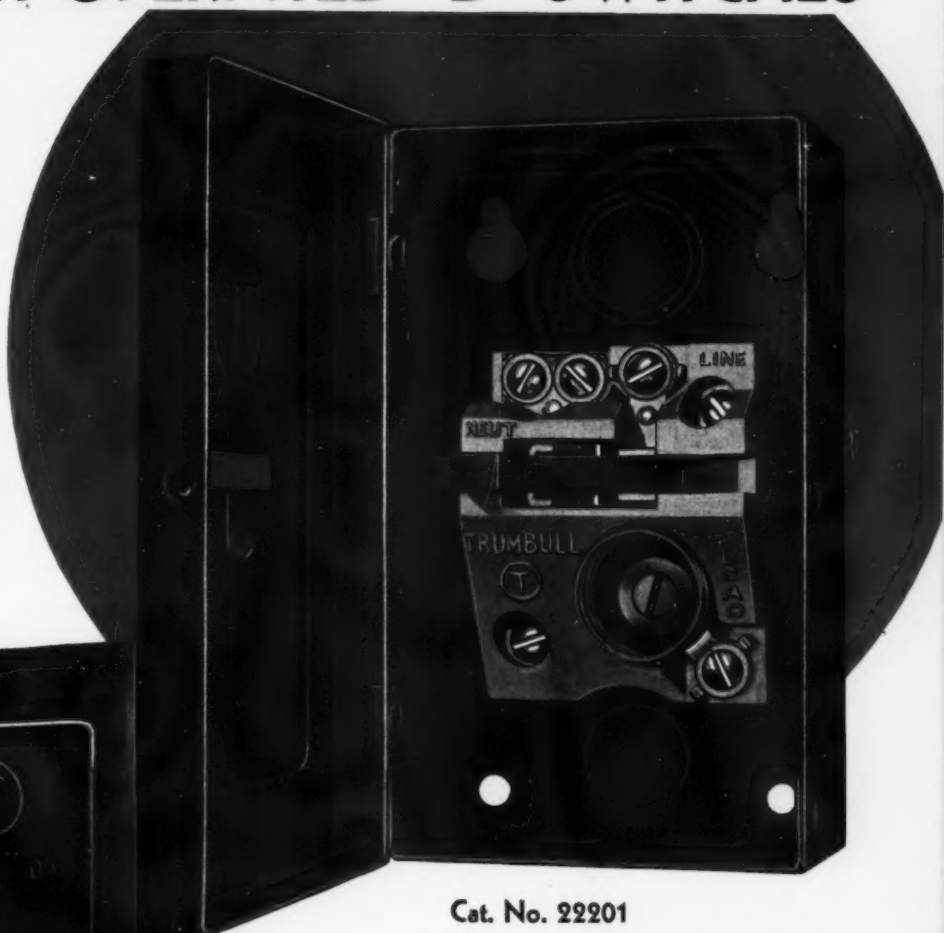
# NOW, FRONT OPERATED "D" SWITCHES

## GENERAL USES:

May be classified as follows

1. For controlling motors, 115 volt single phase or direct current.
2. For controlling heavy duty lighting circuits.
3. On domestic or industrial heating devices.

*Particular Applications*, — mounted as a unit or in connection with Oil Burners, Small Air Compressors, Domestic Refrigeration, Stationary Vacuum Cleaners, Flood Lights, Signs and Grounds Lighting, Factory Lofts, Warehouses and General Lighting Circuits, Entrance work on small detached buildings. Miscellaneous use where fusing is desired.



Cat. No. 22201

## 30 AMP. 125V. PLUG FUSES FEATURES

Front operation Double break contacts  
Entire unit easily removed from Box (loosen 2 screws)  
Very compact Terminals and fuses easily accessible  
Can be locked in either "on" or "off" position  
Provision for sealing cover Ample room for wiring  
Arc is snuffed in recesses in base.

30 Amp. 125V.

For Plug Fuses

Porcelain Base

Cat. No.	Amp.	Volt	Pole	Blades	Fuses	Outside Box Dimensions	List Each
22201	30	125	2S.N.	1	1	3 1/16" W. x 6" L. x 3 5/8" D.	\$1.90
22211	30	125	2	2	2	5" W. x 6 5/8" L. x 2 3/4" D.	2.00

† For side operated see No. 24111, page 30, Cat. 16.

‡ For side operated see No. 24211, page 29, Cat. 16.

SEND FOR THE  
TRUMBULL  
No. 133  
"USE" BULLETIN  
OF  
ENCLOSED SWITCHES



# The TRUMBULL ELECTRIC MFG. CO.

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NEW YORK • CHICAGO • BOSTON • DETROIT • ATLANTA • PHILADELPHIA • LUDLOW, N.Y. • SAN FRANCISCO, CALIF. • LOS ANGELES, CALIF. • SEATTLE, WASH.



# Code Chats.....

**Questions and answers relating to the interpretation of the National Electrical Code...**

**Conducted by F. N. M. Squires**

*Chief Inspector New York Board of Fire Underwriters*

## **Service Breaker as Controller for High Voltage Motor**

Rule 5005-a states that "if an installation consists of a single motor operated at the supply voltage, the requirement for a circuit-breaker may be met by the service circuit breaker."

Does this mean that when a service just supplies one motor (no lights) the service circuit-breaker only could be used as the controller?

Yes, if the service circuit-breaker and the motor are within sight of each other and the circuit breaker presents the necessary protective features, the service circuit-breaker can serve as the motor controller.

## **Service Entrance Cable for Range Wiring**

Under separate cover I am enclosing a sample of service cable, which does not have the flat steel armor.

Do you recommend this for three-wire 110-220-volt ranges, or is there anything in the Code pertaining to the use of this? Also can this be used for outside house entrances which feed in the cellar?

The sample submitted was a piece of service entrance cable having two insulated conductors and the so-called bare neutral. The uninsulated neutral conductor was stranded and wound in a layer over the two rubber covered conductors. Over the bare neutral was a rubber impregnated tape and over the tape was an outside braid.

This cable could be used for service entrance work from an overhead supply line but is not for use underground, as it is not of the U.S.E. type. Also, as it was not of the protected type it would have to be protected by conduit or armor if run where subject to mechanical injury.

Its use for range wiring would be permitted under Section 513 for use

on a 110-220-volt circuit for range circuit only.

It should be remembered, however, that the frame of the range must not be connected to the neutral conductor of the cable. If the frame of the range is to be grounded some other grounding conductor than the neutral must be employed.

## **Feeder Size for Store and Apartment**

To determine the size of the feeder for a store which also has an apartment connected with it, is it necessary to add the area of the apartment to the area of the store?

No, the demand for the store should be computed according to the area of the store part in compliance with 2002-d, 4 and 5 and to this should be added the demand for the

apartment in compliance with 2002-d 1.

Another phase of the above layout which has caused several inquiries, is in reference to a storeroom in connection with a store.

For this storeroom we need not use the demand required for a store for the storeroom area but should add the definite connected load to be used in the storeroom to the demand for the store.

## **Feeder Capacity**

Does Paragraph 2 2002-c mean that the combined lighting and power load determined as specified in paragraph 1 of 2002-c for lights, and paragraph 3 of 808-a-3 for power, shall be added together?

Yes, this means that to compute the size of feeder required for a building in which both light and power are taken from the same feeder, we figure the capacity required for lights by means of 2002-d and add to that the capacity required for power in accordance with 808-a.

## **Common Grounding Wire**

Section 908-h and 909-j states:

"Such common grounding conductors or separate conductors if used under conditions where a common conductor is permissible."

Does this mean that separate grounding conductors could be used instead of the common grounding conductor?

Rule 908-h permits the use of a single, or common grounding wire providing it meets the current carrying capacity of rule 908-l and providing that there is at least one other ground at some other point on the secondary distribution system. The Code, in 908-a and b, 908-k, and 908-l, gives size requirements for three sorts of grounding conductors. If a single grounding conductor is used to serve all three of these purposes it must be of the maximum size required by any of those three rules. Of course, all three of these requirements pertain to a.c. installations while only two to d.c. installations as the neutral of a d.c. system is not to be grounded at the individual service.

If the inspector did not allow a common grounding conductor, how else could it be done?

If a common grounding conductor is not permissible under the provisions of the Code, as might be the case where a transformer supplies a single building and there is no grounding connection at the trans-



**A FLOOD WATER MYSTERY:** Just what took place when the Hartford flood waters submerged this 1,000-amp., 600-volt switch, may never be known. In service at the time between a substation and street railway feeders, the four large lugs at the lower end were consumed as if by electrolysis.



# U.S. Tape

## COSTS NO MORE

Whatever your friction or rubber tape requirements, you will always find a "U. S." tape to fill the bill. For quick, neat, permanent jobs these tapes have won an ever-growing following among electrical contractors.

These brands of tape are famous for their durability and uniformly high tensile strength. Look for the "U. S." trademark when you buy tape.

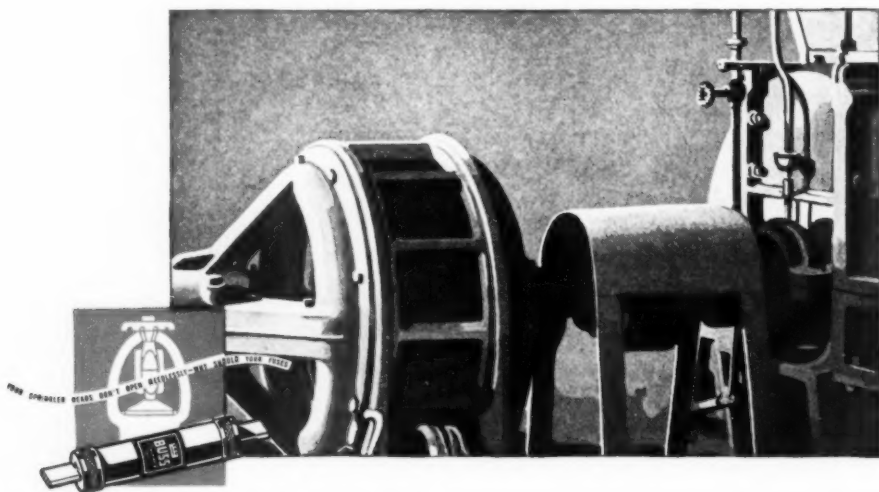
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U. S. Relio  
U. S. Holdtite  
U. S. Gray  
Perfection  
Usco

United States Rubber Company

United States  
Rubber Products, Inc.,  
New York, N. Y.



# FUSES MADE TO *protect*



*"We cut fuse blows  
from 3 per week to 1 in sixty days"*

**HERE ARE THE FACTS . . .** Mr. Arthur Lind, Chief Electrician of the Lumber and Veneer Plant of Elliott Bay Mill Co., Seattle, Wash. speaking, "The 188 amp. 440 volt motor on our fuel grinder was blowing ordinary 300 amp. fuses about three times per week. Two years ago we switched to BUSS Super-Lag fuses and cut our blows to not over one in sixty days. Furthermore, we can now trace these few blows to incorrect handling of the machine by the operator."


**Like Mr. Lind thousands of other production-minded executives are finding that it pays a handsome profit to investigate fuses that . . . .**

# ... NOT TO BLOW !

## ... prevent the RECURRING SHUTDOWNS caused by NEEDLESS BLOWS

"Self-built" fuse hazards that so often fool ordinary fuses into blowing needlessly have no place in "Fuses made to protect—not to blow." For isn't it obvious that the troubles that blow fuses *should* originate in circuits—not in fuses? If you are at all interested in plant operation, why not find out for yourself...

**WHY BUSS FUSES DON'T**



**10 Features**  
in the design of the  
FUSE-CASE help make  
it possible and ....

**BLOW NEEDLESSLY**

**The Super-Lag**  
development in the  
FUSE LINK completes  
the job.

## GET THE FACTS

Assuming your interest in getting the facts on the relation of plant operating costs to fuse design, we have gone to great lengths in this book to set them up for your consideration.

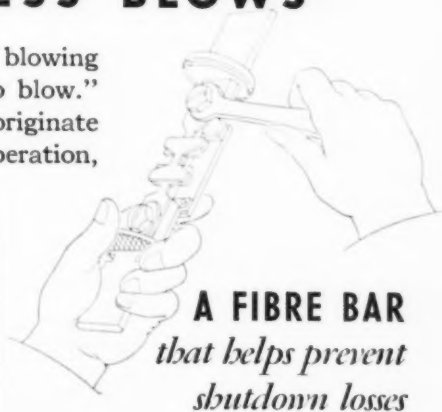
We will send you a copy free immediately upon receipt of your address. Ask for the Rb book.

BUSSMANN MFG. CO.  
2536 W. University St.  
St. Louis, Mo.

A Division of the  
McGraw Electric Co.



**FUSES MADE TO PROTECT...NOT TO BLOW  
REFERS ONLY TO BUSS SUPER LAG FUSES**



It's not an ordinary fibre bar. It is used **ONLY** to make it easy to renew the fuse correctly.—It is not **DEPENDENT UPON** to hold the terminals in line **AFTER THE FUSE IS RENEWED**. Let's see why that's important.

When the BUSS fuse is renewed the terminals are automatically brought into line and positively locked at each end of the case.

Warping or swelling of the bar cannot twist the fuse terminals and cause poor contact in the fuse clips.

**BUT** ordinary fibre bars that support the terminals after the fuse is renewed—are often the hidden cause of mysterious fuse blowing.

When the fuse caps are pulled down tightly the flexible bar turns with them and pulls the terminals out of line. This spreads the fuse clips when the fuse is inserted and causes poor contact.

Worse still, even if the fuse is correctly assembled, any warping, or swelling of the fibre bar will force the terminals out of true **WHILE THE FUSE IS IN USE**. Spring clips cannot hold terminals in line against such a force.

The result is poor contact—needless blows—useless shutdowns.

**THAT'S WHY BUSS** does not depend on a flexible fibre bar for the vital good contact necessary—in a fuse made to protect—not to blow.

*it's full of life  
- because it's a better tape!*

**RUBBER  
ASTM  
AMAZON  
TAPE**

**RIGIDLY  
TESTED**

Victor [Friction and Rubber] and Stick  
Tapes also Distributed and Guaranteed  
by GRAYBAR.

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QUALITY  
SINCE 1869  
Distributed and  
guaranteed by  
Graybar  
ELECTRIC COMPANY

OFFICES IN 78 PRINCIPAL CITIES.  
EXECUTIVE OFFICES, GRAYBAR BLDG.,  
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Build up prestige and good will by  
installing quality materials in all  
your jobs.

**STEEL CITY  
PRODUCTS**

help the electrical contractor gain a  
reputation, not only for furnishing  
quality products but workmanship as  
well, because they are manufactured  
in accordance with the workman's  
needs, insuring speedy, dependable  
performance at all times.

We manufacture a complete line of  
outlet boxes, covers, switch boxes, con-  
duit fittings and electrical specialties,  
furnished in sherardized, galvanized,  
enameled or cadmium finish.

**STEEL CITY ELECTRIC CO.  
PITTSBURGH, PENNA.**

Gentlemen:

Please send a copy of your new catalogue to

Name .....

Address .....

WRITE FOR OUR  
NEW CATALOGUE

Single  
Utility  
Outlet

Duplex Utility  
Outlet

Watertight Floor Outlet

former itself, then separate ground-  
ing conductors should be employed.

We might then have one ground-  
ing conductor to ground the neutral  
of the system selected in accordance  
with 908-b, one grounding conductor  
to ground the service conduit or cable  
sheath selected in accordance with  
908-l, and one grounding conductor  
for grounding the interior conduit,  
cable armor, equipment, etc., selected  
in accordance with 908-k.

Of course, we might also have  
other separate grounding conductors  
grounding isolated pieces of equip-  
ment, isolated runs of conduit,  
armored cable, etc., which, if possi-  
ble should be connected to grounded  
conduit or armor, but, lacking this  
possibility, may be grounded also to  
the water piping within the building.

### Sign Leads

*Is rule 3807-d intended for the  
wiring between a building and the  
sign.*

Yes, Section 3807 of the Code  
governs both the wiring of the sign  
and the wires connecting the sign  
to the circuit. Of course, the cir-  
cuit wiring of the sign comes under  
the requirement of Article 5 of the  
Code and open wiring may be used  
if not subject to mechanical injury.

### Outline Lighting Insulation

Rule 3805-a states that outline  
lighting shall be constructed entirely  
of metal or other approved non-com-  
bustible material.

*Does this mean that a gas tube  
used for outline wiring must be  
mounted on a metal base?*

*On such jobs as I have seen where  
the gas tube outlines a building no  
metal was used. The tube merely  
being secured to a glass insulator  
which was secured to the building.*

While it appears from the word-  
ing of rule 3805-a that it might be  
required to mount the gas-tubes on  
a metal backing or trough where  
gas-tube outline lighting is em-  
ployed such was not the intent of  
the Code. If such had been the in-  
tent it would prevent running the  
gas-tubes over woodwork such as  
the sides or edges of a frame build-  
ing.

There are many such jobs in use  
and inspectors have not objected as  
long as the tubes were properly  
mounted on approved insulators. Of  
course, the high tension wiring and  
tube terminal wires must also be  
properly supported or enclosed.



# N.E.C.A. News..

*Material for this department is supplied  
by the headquarters staff of the*

## National Electrical Contractors Association

420 Lexington Avenue, New York, N. Y.

President	Vice President	General Manager
E. N. Peak	Louis Kallscher	Laurence W. Davis
1603 West Main St.	17 Bergen St.	420 Lexington Avenue
Marshalltown, Ia.	Brooklyn, N. Y.	New York, N. Y.

### Atlanta-Biltmore Selected for Convention

The Atlanta-Biltmore Hotel has been chosen as headquarters for the N.E.C.A. 1936 Convention to be held in Atlanta, Ga., on October 5, 6 and 7.

The Atlanta-Biltmore is ideally located, about a mile out from the center of the city, and is one of the finest hotels for convention purposes that the N.E.C.A. has ever selected. The rates for rooms at the hotel are very reasonable, starting as low as \$3.00 per person for single rooms, and \$4.50 for two persons in double rooms. Every facility of the hotel is designed for handling conventions most efficiently.

### President Peak Completes Western Trip

On May 22 President Earl N. Peak visited Omaha, Neb., as the last stop on his seven-week western trip, having covered some 6,200 miles and visited more than twenty-five cities in thirteen states and the Province of British Columbia.

In every city that Mr. Peak has vis-

ited a great deal of enthusiasm has been created in the program inaugurated by the N.E.C.A., and much interest has been shown about the program that is being sponsored by the four major groups of the electrical industry under the Electrical Industry Promotion Committee. In fact, letters being received every day at N.E.C.A. headquarters from these different cities report that intensive organization activities are under way in each of them in preparation for cooperation with the entire program.

### Southeastern States Active in Organization Work

General Manager Davis on his trip through the southeastern states reports an active interest in association activities being taken in every state he has visited. Plans have been completed in Alabama, Tennessee, Virginia, North Carolina, South Carolina and Georgia for a field man in each of the states to carry on organization work for the strengthening of state and national membership. In other states plans for state and more local associations are likewise under way.

### A Challenge to Electrical Contractors

By Ralph M. Walker, chairman  
Committee on Distribution, N.E.C.A.

The thing most talked of at the last National Convention was securing for the qualified contractor his rightful place in the electrical industry. A qualified contractor is one who performs the following functions:

1. Creating demand for electrical products by salesmanship, contact with consumers and market development;
2. Building good will for and exploiting the products of particular manufacturers by recommending and using such products when installation contracts do not call for parts by trade names;
3. Making no substitution for specified products where the manufacturer has created a specific demand;

4. Supplying engineering experience in the proper assembling of the diverse products of different manufacturers and combining them into a balanced installation;

5. Guaranteeing the successful operation of the entire installation, including the parts contributed by each manufacturer; and

6. Supervising and servicing the successful operation of the equipment after it is installed, thereby assuring continuing good will for the products.

Contractors have had many troubles but it is believed that they would all disappear if proper relations between contractors and between contractors

and other branches of the industry could be established.

Proper relations between contractors depend largely on local associations. They exist in many localities and should be formed in every locality. N.E.C.A. offers an excellent plan of local organization, which will be furnished on request.

Proper relations between contractors and other groups, manufacturers, jobbers and utilities, cannot be had until many contractors change both their buying and selling policies, until there are changes in some policies of both manufacturers and jobbers, until there is better feeling generally between contractors and utilities, and until there is both local and national cooperation in bringing these changes about. Conferences with leading manufacturers, jobbers and utilities have disclosed a sincere desire to cooperate with the contractors, but a feeling that the contractor group is not organized to carry out any policy that may be agreed upon between the different groups.

The officers, the executive and other committees of N.E.C.A. have worked out sound plans for industry cooperation and are giving freely of their time and energy in trying to realize them, but no plan however sound is worth repeating unless put into operation. No committee however capable can do more than prepare plans—putting them into operation is the business of every contractor in the business.

Through the efforts of our president a national committee has been formed, composed of leaders in all branches of our industry. Its purpose is to plan better cooperation between all branches of the industry. This is the Electrical Industry Promotion Committee. Our representatives sit as equals on this committee, our president is its chairman, but it might as well not meet unless there is going to be a similar committee in every community to give effect to its policy. The influence of the contractor members will be nil, unless backed by an effective National Association, and this should be made up of members who are also members of state or district associations and local associations throughout the United States. The objectives of these local and state associations should be to see that the contractors measure up to their own responsibilities and secure the carrying out of the national plans.

#### Challenge

If you are one of the contractors who complain that N.E.C.A. has not accomplished what it should, remember that an association is exactly what its members make it.

Have you helped to organize and maintain a local association? Have you helped to form a local industry promotion committee or electrical league to promote cooperation and good fellowship between contractors and between contractors and other branches of the industry? Are you expecting your job-

# BWH TAPES



Tape is used by the roll; yet for many years it has been sold by the pound. Weight does not contribute to economy. It is footage that counts—and that's why B.W.H. Tapes, made and used by the roll, are also sold by the roll.

When you buy B.W.H. Tapes you get guaranteed footage. A roll bought today or six months from now gives you exactly what you pay for—a definite quantity of tape, always the same, and always identical in character.

If you agree with us that footage rather than weight is what really counts in tape, order B.W.H. brands of Friction Tape or Splicing Compound. This insures your receiving maximum tape value as well as a brand nationally known and made by the oldest tape manufacturer in the industry.

## BOSTON WOVEN HOSE & RUBBER CO.

# FRICTION TAPE



All B.W.H. Friction Tapes are built on strong, closely woven sheeting, thoroughly impregnated with live rubber friction of strong, adhesive quality. Bull Dog Tape, nationally advertised for many years, is identified everywhere by the well known slogan — "It Sticks - It Holds - It Lasts".

# RUBBER TAPE



B.W.H. Rubber Tapes are made of exceptionally high grade unvulcanized compound, accurately cut and tightly wound between layers of Holland sheeting, — always moist and ready for instant service.

## CAMBRIDGE, MASS.





## *A new name over the door*

**O**N March 24, 1936, the old familiar name, Consolidated Gas Company, was changed to Consolidated Edison Company of New York, Inc.

Thus the name of the great American whose first central station in Pearl Street, New York City, was the beginning of the electrical industry, takes its appropriate place in our corporate title.

It has long been borne by two of our largest affiliated companies. It not only symbolizes a great tradition, but also expresses to a large extent the present scope and service of the Company.

AFFILIATED COMPANIES OF  
**CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.**  
ELECTRIC, GAS AND STEAM SERVICE FOR BUSINESS AND THE HOME



**INSTALLS HIGH INTENSITY LIGHTING:** Two of downtown Cincinnati's brightly lighted retail stores have recently been wired by the Bertke Electric Co. One store, with 300-watt window outlets on 14-in. centers, is said to have had over 50 f.c. on its sales floor, while the other reads 48 f.c. Arthur E. Bertke has served for the past three years as president of the contractors association, and is now its acting president during the interim of reorganization which is coupled with an intensive membership campaign.

bers to protect you while buying from other sources? Are you a friend of your local utility? Are you supporting manufacturers with decent policies by buying their products or are you buying the cheapest thing you can get, regardless of the policy of the manufacturer? If you are not satisfied with the accomplishments of N.E.C.A., what have you put into it?

A little work by a single leader in each community could soon result in a strong local contractors association, and a local industry promotion committee. The local contractors associations should be welded into state or district associations to put into effect plans worked out by N.E.C.A. and the national Electrical Industrial Promotion Committee. Together we can get what we want, singly or in small groups we can't. It is up to each contractor to get busy and to do his part toward securing our objectives, or forever to hold his peace. Let's go!

**C**ONTRACTORS of Louisville, Ky., were presented by the local power company with courtesy copies of neatly-installed service equipment up to the depression days. This activity has recently been resumed, except that these copies can be had at a nominal charge which is considerably less than the cost of making the original photo. Walter B. Diecks, of the Walter B. Diecks Electric Co., who has many of these photos in his office, is of the opinion that the power company's cooperative photographing plan caused the local contractors to take special care to make neat and workmanlike service and metering equipment installations.



# Contracting . . . .

## News . . . . .

### Florida Set for Big Membership Drive

At the annual convention of the Florida Association of Electrical Contractors and Dealers plans were laid for an extensive membership drive with a quota set for 700 new members for 1937. The convention which was held at the San Juan Hotel in Orlando on May 18 had a session for contractors and members only in the morning, and a joint industry session in the afternoon. The meeting was addressed by L. W. Davis, general manager of N.E.C.A. and A. Penn Denton of the Rigid Steel Conduit Manufacturers Association.

William Hepburn of Miami was elected president; J. J. Newell of Orlando, vice president; Harold N. Lang of Orlando, secretary; and R. C. Bigby of Tampa, treasurer. The committeemen elected were as follows: H. G. Miller, Jacksonville; Henry Lipscomb, Lakeland; A. T. Wilson, Fort Pierce; D. A. Newsom, Tampa; B. A. Ragsdale, Tallahassee; and S. W. Shaw, Tampa.

### Four Hundred Million More for Farm Electrification

Federal aid to rural electrification through the loans of low-interest funds is assured for ten more years by the final enactment of the Norris bill, which was signed by President Roosevelt on May 20. The measure authorizes the use of \$410,000,000 over the ten-year period.

Action followed promptly the report of the conference committee of the two houses, which had been deadlocked for five weeks over conflicting provisions in the two versions. Principal point of difference was over loans to privately-owned utilities, which were allowed by the House, but excluded by the Senate. A compromise was finally agreed to by which such loans may be made, but preference is given to loans granted to local governmental agencies, cooperatives, and non-profit or limited-dividend corporations. This corresponds with the powers of the present Rural Electrification Administration, a temporary agency set up under the provisions of the Relief Act of 1933, which will be taken over by the new REA.

Beginning July 1, funds for the loans will be provided by the Recon-

struction Finance Corporation up to a limit of \$50,000,000 during the first fiscal year. Thereafter Congress is authorized to appropriate \$40,000,000 per year for the next nine years. Loan interest is set at the rate paid by the federal government for ten-year obligations during the year preceding the signing of the contract, but at 3 per cent during the first year. All loans must be self-liquidating within a maximum of twenty-five years for transmission or generating facilities; five years for house wiring and the acquisition and installation of electrical and plumbing appliances. The second type of loans shall not be made to individual customers, but to the local project sponsoring organization or to the contractor who makes the installation.

### New York State Meeting

The annual convention of the New York State Association of Electrical Contractors and Dealers will again be

held at Big Moose on June 22 to 25. The speakers include S. J. Hibben of Westinghouse Lamp Company, L. W. Davis of N.E.C.A., Bert Kirkman, local No. 3, I.B.E.W., George Richards, of Safecote Wire Manufacturers, Samuel Rosch of Anaconda Wire and Cable Company, and George Reickert.

### Wisconsin Contractors to Meet in August

The regular summer meeting of the Wisconsin Electrical Association will be held at the Hotel Witter, Wisconsin Rapids, on August 3 and 4. The preliminary program includes a discussion of state licensing and inspection, rural electrification, manufacturer and wholesaler policies, and utility relations. An exhibit of manufacturers' products will be held.

### Two Carolinas Form Association

The Carolinas' Association of Electrical Contractors was organized on May 4 with the following officers: J. A. Johnson, Winston-Salem, president; Du Pont Guerry, Jr., Greenville, vice-president; E. R. Edman, Winston-Salem, secretary; and R. H. Bouligny, Charlotte, treasurer. C. S. Boger has been engaged as executive secretary.

Each of the two states has been divided into zones with the organizing of each zone to be in charge of a director.

## N. I. S. A. Discusses Expanded Organization

THE necessity for broadening the scope of the work of the National Industrial Service Association and expanding the membership was a recurrent theme at the annual convention held at the Cincinnati Club, Cincinnati, Ohio, April 27 to 29, and which was attended by approximately one hundred members of the repair shop industry. The convention which marked the conclusion of the first three years of association activity gave consideration to new programs, chapter coordination, higher dues, paid staff and field work, leaving the decision on these questions to the incoming board and officers.

E. C. W. Johnson, Scherer Electric Company, Indianapolis, Ind., was elected to succeed F. W. Willey, Willey-Wray Electric Company, Cin-



President F. W. Willey

cincinnati, as president. The other officers are vice-president, W. J. Wheeler, Maintenance Company, New

# Products with the

# 2



## Easy Cleaning—Foolproof Assembly of Jefferson-Union Renewable Fuses

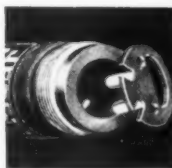
Jefferson-Union Renewable Fuses offer extra life—extra value. One of the most important factors in the life of a fuse casing is cleaning—all volatilized link metal must be removed after blowing.

There are no obstructions to cleaning in a Jefferson-Union Casing. Smooth, no crevices, all traces of volatilized metal can be speedily removed. The fiber used—selected for toughness—is another reason why Jefferson-Union Casings withstand repeated blowouts.

Jefferson-Union Fuses are quickly renewed—save shutdown



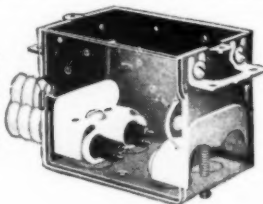
time. They are simple—few parts to handle. The fuse cannot be assembled wrong; the fuse assembly is properly aligned automatically. The fusible links are designed for speedy renewal—knife-blade link notched and ferrule type blade rounded at end for quick insertion.



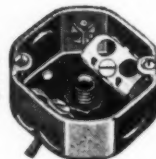
## Jefferson-Gem Switch and Outlet Boxes

Boxes for every purpose are included in the Jefferson-Gem line—well-known to electrical contractors for over a quarter of a century.

Gem X Sectional Switch box with clamps and Pri-outs.



Jefferson-Union Octagon outlet box No. 1288-X with Pri-outs in sides and bottom.



## Door Bell Transformers

The small door bell transformer is an important item in the complete line of door bell and signaling transformer carrying the Jefferson label—all sturdily built for long trouble-free service.

Jefferson-Wizard Door Bell Transformer.



## Sales Opportunity in Jefferson Transformers

### for Mercury Vapor Lamps

The high efficiency of mercury vapor lamps has already developed a great deal of profitable modernization business.

Jefferson Transformers for this work assure exceptionally efficient operation.

The full rated capacity of the lamp is realized—consumption is low, particularly noticeable during the initial starting period—cool operating temperatures are maintained even on continuous service.

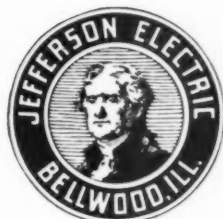
Made in types to meet all installation requirements. The two shown are—above, wall type, below, fixture or suspension type.



# ESSENTIALS

## QUALITY...

## REPUTATION



**F**OR profitable selling of any product, quality is essential. But quality alone is not enough. The buying public must know the product is good. Otherwise, the salesman has a double job to do.

The quality of Jefferson Products is well known throughout the trade. The Jefferson reputation for quality extends back to the beginning of electrification. And Jefferson Engineers have made more than their quota of contributions to the improvement in design and performance of all types of small transformers and fuses.

**JEFFERSON ELECTRIC CO.**  
BELLWOOD (Suburb of Chicago) ILL.  
Canadian Office: 535 College St., Toronto

### Sell the Savings from Jefferson Air-Cooled Transformers

By permitting the operation of lights and small 110-V. appliances off of higher-voltage, low-rate power circuits, Jefferson Air-Cooled Transformers offer a profitable investment. Nearly always they reduce wiring and wiring maintenance by eliminating duplication of circuits. Often this saving alone pays for the transformer. Incorporating the vast fund of knowledge gained through decades of experience, fully enclosed, convenient to install, approved by Underwriters' Laboratories, these Jefferson Air-Cooled Transformers offer quality and reputation from which you can profit.



# JEFFERSON



York; secretary, J. E. Launder, Independent Electric Machinery Company, Kansas City, Mo.; treasurer, Alfred L. Brown, A. L. Brown Associates, Inc., Worcester, Mass.; executive committee, W. W. Hahks, Charlotte, N. C.; Arthur Turner, Tampa, Fla.; W. J. Wheeler, New York; H. H. Roessle, Pittsburgh; A. F. Anderson, Nashville, and Roy T. Hyre, Chicago.

In opening the convention President Willey briefly outlined the relation of the association to its industry pointing out that it has three thousand business units with a capital investment of approximately \$75,000,000. The work of the association has been devoted to better standards of workmanship and salesmanship, information on improved business methods, exchange of ideas, interchange of equipment, posting of members on national movements of business or political nature affecting the industry and defending the industry against invasion of its rights.

A discussion on local group cooperation was lead by R. W. Barkley of Cincinnati. Such cooperation, he stated, should foster good business ethics, common honesty both to members and the public, open discussion of methods and costs, interchange of credit information, availability of merchandise and specialized services with worthwhile discounts, establishment of high standards of workmanship and full support of the national association.

In the discussion Roy T. Hyre stated that the Chicago group was trying to keep the motor business within the group by interbuying between members. They also have manufacturers attend their meetings in order to acquaint them with the work of the group and to recognize the dealer as a competent distributor



Officers: Front row, W. J. Wheeler, New York, vice president; E. C. W. Johnson, Indianapolis, Ind., president; A. L. Brown, Worcester, Mass., treasurer. Standing, F. W. Willey, Cincinnati, Ohio, retiring president, J. E. Launder, Kansas City, Mo., secretary.

with adequate discounts. C. A. Sievert, also of Chicago, told what the group had done to standardize and reduce costs of telephone book advertising. He also mentioned their credit bureau.

In Florida, Arthur Turner stated, where there are twenty-six members of the state association, a price book has been developed.

With respect to national cooperation W. J. Wheeler stated that it could only act as a medium for interchange of information and data between sections. The development of the local organization was a local problem, voluntary in nature.

A. G. Carson, associate editor of *Electrical Manufacturing*, and S. B. Williams, editor, *ELECTRICAL CONTRACTING*, spoke on the cooperation of trade papers.

A paper on "Service Shop Sales Methods" was delivered by J. E. Launder, Kansas City, in which he emphasized the necessity for personality.

W. J. Wheeler of New York presented a paper on "Service Shop Guarantees" outlining the plan now being used by the New York chapter. Instead of "guaranteed," they are making "certified" motor repairs, using a specially designed copyrighted emblem for identification and publicity. They have developed stickers, shipping tags and literature. Certification is restricted to quality shops which must be approved by a certification committee. The value of the plan, he stated, lies not in the standards or guarantee, but in the wide spread publicity to motor users.



Group photograph taken at 1936 Cincinnati convention, N.I.S.A.



**PANTHER and DRAGON  
FRICTION and RUBBER  
TAPES**

**CELLOPHANE WRAPPED  
PANTHER  
FRICTION TAPE**  
HAZARD INSULATED WIRE WORKS  
DIVISION OF  
THE OKONITE COMPANY  
No 8  
3/4"

**CELLOPHANE WRAPPED  
FRICTION TAPE**

**CELLOPHANE WRAPPED  
PANTHER  
FRICTION TAPE**  
HAZARD INSULATED WIRE WORKS  
DIVISION OF  
THE OKONITE COMPANY  
No 8  
3/4"

**CELLOPHANE WRAPPED  
DRAGON  
FRICTION TAPE**  
HAZARD INSULATED WIRE WORKS  
DIVISION OF  
THE OKONITE COMPANY  
No 8  
3/4"

**For Greater Protection**

## HAZARD INSULATED WIRE WORKS

*Manufacturers of Insulated Wire and Cable for Electrical Contractors*

*Division of*

## THE OKONITE COMPANY

Factories:

Wilkes-Barre, Pa.

Passaic, N. J.

## SHERMAN FIXTURE CONNECTORS BRASS OR BRONZE

APPROVED



Corner View  
U. S. Pat. No. 1352932



End View

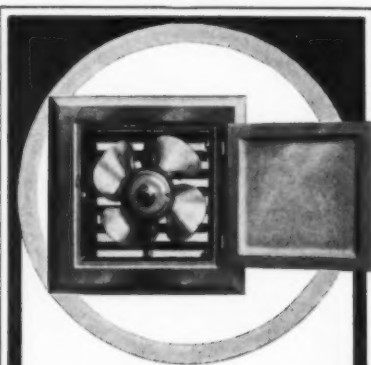
### THE PERFECT SOLDERLESS CONNECTORS

Only One Size Needed  
Fits all wires No. 12 or smaller  
The screws can't come out  
All Brass—(or Bronze)  
Simple and Quick

The bronze fixture connectors are made especially for outdoor use. Universally favored for Neon sign work. Made of high copper bronze—weather resisting. Construction same as the brass.

Free samples on request

SOLD THRU JOBBERS  
H. B. SHERMAN MFG. CO.  
BATTLE CREEK, MICH.



### Automatic Wall Box Kitchen Ventilator Fan

Built-in type for permanent installation, it is telescopic in design, adjustable to wall thickness 7" to 13". No wood or metal frame or screws in the plaster, wood, or brick necessary. Inside and outside polished cast aluminum; wall box rust resisting steel. Quickly installed in old or new homes. Automatic switch and shutters controlled by opening and closing of the door. 16" silent blade fan; available for A.C. or D.C.; A.C. non-radio interfering. Write for bulletin and prices.

SIGNAL ELECTRIC MFG. CO.  
Menominee, Michigan, U. S. A.

OFFICES IN PRINCIPAL CITIES

# SIGNAL

At the conclusion of this address it was voted to appoint a committee to make a study of this and any other similar plans.

A chart covering data needed to rewind a 2-phase motor for 3-phase operation was explained by F. W. Willey. This chart will appear in a subsequent issue of ELECTRICAL CONTRACTING.

One of the papers that received greatest interest was that on "Overhead" by E. C. W. Johnson, the new president. Questionnaires on selling volume, cost and profits, sent out by the association developed such wide differences as to make the information of little practical value for comparative purposes. It was possible, however, to develop an average detailed overhead statement for a motor repair shop with a gross volume of \$30,000 showing the relation of various items. This follows:

#### AN AVERAGE REPRESENTATIVE OVER- HEAD FOR A MOTOR REPAIR SHOP BASED ON GROSS SALES OF \$30,000

Advertising and sales promotion.....	2.5%
Association dues and subscriptions.....	.3
Concessions, bad debts, etc.....	.5
Depreciation.....	1.0
Interest.....	.3
Insurance.....	.5
Printing, stationery and supplies.....	.2
Rent or plant depreciation and repairs..	3.0
Salaries, executive, office.....	10.0
Shop expense—tools, replacement.....	1.0
Taxes.....	1.7
Telephone, Telegraph, Postage.....	.7
Transportation.....	1.0
Water, Gas, Electricity, Heat.....	1.0
Miscellaneous, not included.....	1.2
	<b>24.9%</b>

The convention voted to have the association seek further information on costs.

A series of three shop forms designed to show the cost of labor and material on any job were shown and explained by George F. Stratton of Charlotte, N. C.

On the practical side of shop operations, J. E. Laundry presented a suggested list of tools to be furnished by the workmen with their own money. The list was made up from a canvass of twenty shops in different parts of the country. F. M. Mielke of Duluth presented drawings of a shop layout, a cleaning tank, a work bench and a small tester, all of which he developed. A discussion of varnish for shop work by J. J. Connors, Irvington Varnish Company, drew many questions.

The Trading Post, a rebuilt motor exchange service being operated by the Chicago group was explained by



**BUSY MIAMI:** One of the largest re-wiring jobs to be done among the "boom-built" buildings in Miami, Fla., was recently completed by Wm. Hepburn & Company, local electrical contractors. A large chain store found its old wiring system inadequate to operate new 3-element lighting units and air conditioning apparatus. Complete re-wiring was done without closing the store, including No. 10 wire for all branch circuits over 150 ft. long, and No. 12 for all other shorter runs.

C. A. Sievert. This handles only odd stock, no standard motors. Each member sends to the Trading Post a card with the complete nameplate listing of each odd motor in his stock. Any one requiring an odd size may then learn who has such a machine in stock. No quotations are made by the Trading Post. The number of listings a member may make is determined by the amount he pays.

In Florida a similar service lists all motors allowing a discount to members on all motors 5 hp. and up as follows: Below 100 hp., 20 per cent; 100 to 300 hp., 15 per cent; above 300 hp., 10 per cent.

A number of suggestions were made with respect to dues and future activities of the association after papers on these subjects had been read by A. F. Anderson, W. J. Wheeler and F. W. Willey. It was voted to instruct the incoming officers to study these suggestions and make recommendations.

The final day was given over to a visit to the Columbia Park generating plant of the Union Gas & Electric Company with a final business session in the afternoon at which the following papers were scheduled: "Prices and Price Schedules" by Paul G. Winter, Indianapolis; "Discounts for Resale" by Arthur Wagner, Chicago; "Ratio of Coil and Rewind Price" by J. W. Overstreet, Columbus, Ohio, and "Manufacturers Sales and Service Policies" by R. A. Scherer, Indianapolis.



## **"I use the Buyers Reference Number daily—it simplifies my buying"**

The prominent electrical wholesaler who made the above comment added, "I keep my copy in my desk drawer and refer to it constantly to get quotations from manufacturers, locate new sources of supply, and for correct firm names, addresses and trade names."

The Buyers Reference is also used by the president of this organization and his two purchasing agents to fill orders received by

mail and telephone for items not regularly carried in stock.

This is typical of thousands of comments from important buyers who use the Buyers Reference Number to find out *What to Buy*, *Where to Buy* and *Who makes it*.

**You, too, can enjoy these advantages. Keep your copy of this valuable book handy.**

### **ELECTRICAL CONTRACTING**

330 West 42nd St., New York, N. Y.

***Use the***  
**BUYERS REFERENCE NUMBER OF**  
**ELECTRICAL CONTRACTING**

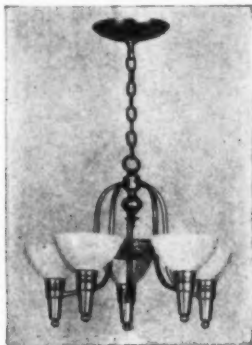
***— to save time and money in your buying***



# New Products . for June . . . .

## Plastic Shade Lighting Fixtures

The "Even-Glow" line of lighting fixtures employs plastic moulded shades



that are claimed to give diffused light. The No. 1220 five-light unit illustrated is one of a complete line of "Even-Glow" fixtures that are featured as providing scientific illumination. Units are made in lantern shapes; ceiling domes; one, two and five-light suspended types; wall brackets; and closet units. A wide choice of finishes may be had. Chase Brass & Copper Co., Inc., Waterbury, Conn.

## Insulation Tester

A compact and portable dielectric or breakdown tester that operates through a small 110-V., 60-cy., transformer to provide 500 to 2,500 volts by means of a rotating tap-changing switch. Recommended for testing the windings or other insulation of appliances and other equipment. The short circuit current is 1 amp. at 500 V., and 200 milli-amperes at 2,500 V. Transformer is claimed to be of the 100 p.c. leakage type and therefore not likely to become damaged when subjected to short circuits for a period of time. Limited current rating is said to elim-



inate insulation materials becoming burned at point of breakdown test. A

special transformer winding energizes a ruby indicating lamp when the 110-V. primary circuit is turned on. This lamp becomes dim under partial breakdown, and goes out on complete insulation breakdown. Acme Electric & Manufacturing Co., Cleveland, O.

## Front Operated Switch

No. 22201 and 22211 switches have porcelain bases and double break arc-snuffing switches with the lever projecting through a hinged cover. The lever may be locked "on" or "off". Made in 30-amp. 125-V. size with one or two blades and with one or two plug fuse connections. The two-blade type is enclosed in a box 5 in. wide, 6 1/8 in. long and 2 1/4 in. deep, while the one-blade type



is smaller. Switch units may be removed by loosening two screws. The Trumbull Electric Mfg. Co., Plainville, Conn.

## Concentric Aerial Cable

A multi-conductor cable recommended for transmission or distribution systems of 2,300, 4,000 and 6,600 V. to ground, in urban, suburban, and rural circuits. Known as type SS aerial cable, it is said to be economical for use in place of bare, weatherproof, and tree wire; or in place of messenger-supported insulated cable. The cable has one or more solid or stranded insulated conductors covered with alternate concentric strands of interlocked steel and electrical conducting wires. This bare concentric covering is intended to serve as a ground shield; as a neutral return conductor of low impedance and resistance; as a means of self-support for aerial spans that eliminates messenger supporting cable; and as protection to the inner conductors against mechanical damage, weather and foreign substances. Cross arms, pins and insulators are not needed, and shorter poles, set farther apart are claimed to suffice. This cable is recommended for use on poles with telephone or other

types of circuits with minimum possibility of interference. Available in varnished cambric, rubber and synthetic compound insulations, and with one or three insulated conductors within the bare concentric conductor. General Electric Co., Schenectady, N. Y.

## Residence Lighting Fixture

No. 466 lighting fixtures are recommended for residence use. Made in 12-in.



overall height to take a 4-in. by 4-in. cylinder of crackled amber, C.R.I., or clear cracked glass. The Herwig Co., Chicago, Ill.

## Program Sound System

For larger schools, hotels, department stores and hospitals, where programs may be distributed by means of this system from microphones, from radio receivers, or from phonograph records. Wholly operated from a single cabinet, where all controls are centered, this system includes at this central point flexible switching arrangements, a radio receiver, an electric phonograph, amplifying equipment, and a combination loudspeaker and microphone device.

Because of "talkback" facilities having been provided in this system, certain loudspeakers may also be used as microphones to transmit sound back to the central point. This feature can be used for overhearing in the central office what is happening at any loudspeaker location, such as a school prin-



cipal "tuning in" on a classroom; store executives checking sales conversations; doctors may talk to the central



## ELECTRICAL WARNING SIGNALS AND SIRENS



Type A Siren

Designed for factories, industrial plants, warehouses and cranes. Can be used as a Danger, Start and Stop or as a Call Signal. TYPE "A" Siren takes the place of bells, gongs, whistles, etc., wherever electricity is available. Louder than any bell or gong. Is ideal for factories and plants or yards. Its powerful tone will penetrate through shop or factory. Illustration shows Type "A" Siren with weatherproof housing. Universal General Electric Motor, for AC or DC, any phase or cycle. Any voltage desired from 6 to 250. Length over all 14 in. Diameter largest horn 10 in. Red Duco finish. Write for Bulletin No. 42 on Industrial Signals.

## Industrial Heavy Duty Weatherproof Signal Horns



Heavy duty weatherproof signal horns for use in industrial plants, rail-road shops, foundries, machine shops where signals must be loud to overcome considerable noise. Suitable for indoor or outdoor installations.

The Motor Driven Signals are operated by a powerful, specially developed motor which responds instantly to code call impulses and gives full tone without lag or delay. Order your Siren today.

Write for Bulletin on INDUSTRIAL SIGNALS.

**FEDERAL ELECTRIC COMPANY**

8726 South State St. Chicago, Ill.

Federal No. 20 motor driven horn, 110 volt, A.C. or D.C. current.

# CONTRACTORS- GUIDE

WHOLESALE  
OF WIRING  
DEVICES

CONSTRUCTION MATERIAL  
ELECTRICAL APPLIANCES  
LIGHTING FIXTURES

RIGHT PRICES—  
QUICK SERVICE  
SATISFACTION  
GUARANTEED

Send for Free Catalogs

## CO-OP ELECTRIC SUPPLY CO.

812 W. JACKSON BLVD., Chicago, Ill.

## CLOCK controlled SWITCHES

Ask Headquarters  
**The TORK CLOCK COMPANY, Inc.**  
Mount Vernon, New York

office of a hospital over the nearest loudspeaker. This system is available to provide one or two simultaneous programs, and switching facilities may include up to 60 keys for controlling extensions, with combination, group or individual switch control as desired. The central control unit is housed in a modernistic cabinet 5 ft. 4 in. high, 2 ft. wide, and 16 in. deep. System design by Bell Telephone Laboratories, Western Electric Co., New York, N. Y.

## Over-Floor Raceway

A line of Wiremold fittings for providing surface metal raceway extensions upon finished floors to outlets under desks or tables that are located at some dis-



tance from existing outlets. The No. 1500 raceway is designed to lay flat on the floor and to enclose four No. 12 wires. Its upper portion is bevelled to reduce the possibility of tripping or stumbling. Cross or tee runs of raceway may be made by means of No. 1542 "pancake" junction boxes. Outlet fittings include a No. 1543



duplex receptacle and a No. 1542 telephone outlet. For connecting from wall runs of Nos. 200, 500 or 700 Wiremold, a combination internal elbow No. 1517A is provided. The Wiremold Co., Hartford, Conn.

## Vest-Pocket Light Meter

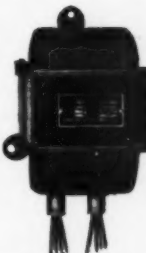
Illumination values as high as 250 f.c. are said to be readable directly from the scale of the vest pocket size Weston Sight-Light Indicator without requiring multiplier discs or other accessories. Low illumination levels are claimed to also be legibly indicated. Sight Light Corp., New York, N. Y.



## Sorgel Air-Cooled TRANSFORMERS

a size and type  
**FOR EVERY  
PURPOSE**

standard stock sizes  
**1/4 to 50 K. V. A.**  
other sizes to order



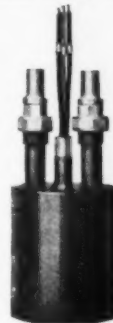
1/4 Kva Single Phase Transformer

**IDEAL and  
ECONOMICAL  
for  
LIGHTING**

**POWER  
VOLTAGE  
BOOSTING**

**PHASE CHANGING  
and other  
INDUSTRIAL AND  
COMMERCIAL  
APPLICATIONS**

Write for descriptive bulletins and prices.



Series Street Lighting Transformer

**Sorgel Electric Company**

437 N. Plankinton Ave. Milwaukee, Wis.

## MINERALLAC Cable or Conduit Hanger Jiffy Clip

Now furnished in EVERDUR as well as Cadmium Plated Steel.



Cable or Conduit Hanger  
Rigid Conduit  $\frac{3}{8}$ "— $2\frac{1}{2}$ "  
Thin Wall  $\frac{1}{2}$ "— $1\frac{1}{2}$ "



Jiffy Clip  
Rigid Conduit  $\frac{1}{8}$ "— $1\frac{1}{4}$ "  
E. M. T. (Thin Wall)  $\frac{1}{2}$ " &  $\frac{3}{4}$ "  
Also BX Cable

Ask your Jobber

**MINERALLAC ELECTRIC CO.**  
25 No. Peoria Street, Chicago, Ill.

New York City Branch  
381 Fourth Avenue

## The Manufacturer's Guide To More Effective Distribution



### "VERIFIED" DIRECTORY OF ELECTRICAL WHOLESALERS

1936 Edition

Completely Revised with  
many new listings

The 1936 Edition includes all desired information (except credit rating) for

1080 "VERIFIED" ELECTRICAL  
WHOLESALERS

Each listing includes

Name and address of firm.

Branch and affiliated houses.

Names of officers and department managers.

Name of purchasing agent.

Territory covered.

Number of salesmen—city, country, counter.

Floor space occupied.

Regular inventory.

Lines handled—supplies, appliances, radio, fixtures.

Year business was established.

Memberships in national and local wholesaler associations.

All at a cost of less than 1½¢ per listing.

Single Copies, \$15.00—Additional Copies, \$7.50

**Electrical Wholesaling**  
330 West 42nd St., New York, N. Y.

## BENOLITE ELECTRIC INSULATION

Reliable electrical machinery demands dependable insulating materials. BENOLITE insulating varnishes and compounds keep electrical equipment on the job—protects it against moisture, acids, oil, etc.

For thirty years we have met and solved insulating problems of electrical machinery manufacturers. Our insulating engineers are anxious to serve you.

**BENOLITE CORPORATION**

Offices: Gulf Bldg., Pittsburgh, Pa.  
Factory: Manor, Pa.

## Trade Notes . .

### Frederick W. Flegel

Frederick W. Flegel for sixteen years general manager of the Reliance Automatic Lighting Company, Racine, Wis., died on April 26 after an illness of nearly a year at the age of 54.

Benjamin Electric Mfg. Co., Des-plaines, Ill., announces the election on April 22 of additional officers as follows: E. E. Bradway, vice-president in charge of operations; J. Horton Fall, III, vice-president and general sales manager; C. F. W. Alfin, secretary and assistant treasurer; D. S. Hazen, comptroller and assistant secretary; B. G. Kodjbanoff, vice-president in charge of its eastern division; Miles F. Steel, vice-president in charge of its Pacific Coast division; and C. B. Harlow, vice-president in charge of its central division.

Allen-Bradley Co., Milwaukee, Wis., has moved its New York, N. Y., offices to larger quarters in the Underwood Bldg., 30 Vesey St.

Cutler-Hammer, Inc., Milwaukee, Wis., has opened a new office at 10 W. Chase St., Baltimore, Md., to be operated under the supervision of the Philadelphia district office. This office will serve the states of Maryland and Virginia. R. A. Haworth will be in charge.

Simplet Electric Co., Chicago, Ill., has made appointments of representatives with branch warehouses, as follows: Associated Sales Engineers, 912 E. Third St., Los Angeles, Calif., for southern California, Clark county, Nev., and Arizona; also Hodges & Glomb, 1264 Folsom St., San Francisco, Calif., for northern California.

Westinghouse Electric & Manufacturing Co., Westinghouse Electric International Co., and Westinghouse Lamp Co., announce the removal of their New York executive and sales offices to the Westinghouse Bldg., 150 Broadway, New York, N. Y.

## Trade . . . . .

## Literature . . . . .

Home Building Prospectus: A 12-page prospectus describing the 1936 "New-American" demonstration home-building program. Publication NAH-102. General Electric Co., Schenectady, N. Y.

Floodlights: A folder describing the MUA line of universal and interchange-

Use the best . . select

# B-L

DRY METALLIC ELECTRONIC RECTIFIERS and DIRECT CURRENT POWER UNITS for

Telephones, Time Clocks, Program Bell Systems, School Laboratories, Sound Systems, Organs, Signals, Chimes and all Special Services . . . Equipped with "Power Off" Relay and Reserve Batteries when specified. . . .

An interesting pamphlet describing B-L Rectifiers is yours for the asking . . . A post card brings it.

**The B-L Electric Mfg. Co.**  
St. Louis, Mo., U. S. A.

Specializing in



### ALL THREAD CONDUIT

Made from Enameled Conduit. Standard sizes in stock—special to order.



### GALVANIZED CONDUIT REDUCER

A very useful fitting. All sizes from 4x3½ to 1½ in.

Write for complete details and prices.

• **G WILLIAM** •  
Manufacturing & Supply Corp.  
4417 North Sixth St., Philadelphia, Pa.



"Standardize on  
STANDARD  
Transformers"

ALL TYPES  
Indoor and  
Outdoor  
Service

Send for  
Descriptive  
Bulletin

**STANDARD TRANSFORMER CO.**  
Warren . . . . . Ohio

# A Simplified Labor-Estimating

## MANUAL for ELECTRICAL CONTRACTORS

Do you estimate  
by guessing?  
Have you up-to-date  
labor unit costs?  
If not, this Manual  
will be invaluable.  
Prices are complete  
and applicable to every  
type of work.  
Price \$2.50 post paid.

### LABOR ESTIMATING MANUALS

732 So. Tay. or Av. St.

Oak Park, Illinois

## Wolverine Lugs Economical to Use

Practical design, superior workmanship  
and high quality materials makes Wol-  
verine Lugs easy to use, hence economical  
to use.

They fit the wires and cables to which  
they are rated—hence save solder and at-  
tach quickly. Holes are correct size and  
the Lugs are smooth, so they handle  
rapidly. Have Underwriters' approval.

Stocks are ample—you can always get  
Wolverine Lugs quickly.

### WOLVERINE TUBE COMPANY

1441 Central Ave. Detroit, Michigan



## E-Z WIRE STRIPPER



Strips insulation  
20 times faster

With a simple squeeze of  
handles it CLAMPS—CUTS  
insulation and STRIPS it  
off instantly and auto-  
matically.

### E-Z WIRE STRIPPER

Saves TIME, LABOR and  
TEMPER. Speeds up pro-  
duction. Lasts a life-time.  
Thousands in use the world  
over. Specified by the U. S.  
Navy, Genl. Elec., Westing-  
house, Otis Elevator, Rail-  
roads, etc. Pays for itself  
first day used. Send wire  
samples please.

Prices \$4.00 net.

**PYRAMID  
PRODUCTS CO.**

2309 So. State St.  
Chicago, Ill.

## CO-OP MONTHLY Contractors GUIDE TO PROFITS

**WHOLESALE  
HEADQUARTERS  
for WIRING DEVICES,  
CONSTRUCTION MATERIAL**  
Lighting Fixtures and Appliances—  
Lowest Prices—Fast Service—  
Satisfaction Guaranteed  
Send for Free Catalogs

**CO-OP ELECTRIC SUPPLY CO.**  
812 W. JACKSON BLVD., Chicago, Ill.

able flood lights wherein one head will  
fit three mountings or nine types of  
floodlight reflectors. Crouse Hinds Co.,  
Syracuse, N. Y.

**Air Cooled Transformers:** A folder  
illustrating air cooled power, signal  
and control transformers for industrial  
applications. Sola Electric Co., Chi-  
cago, Ill.

**Air Conditioning Data:** An engi-  
neering bulletin No. 501 containing 24  
pages of charts and tables giving air  
resistances, speed and horsepower,  
temperature charts for direct expan-  
sion and water cooling, and heating  
data. Brief illustrations and descrip-  
tions of Buffalo type "PC" central con-  
ditioning cabinets are included. Buffalo  
Forge Co., Buffalo, N. Y.

**Commercial Reflectors:** Garey round  
flush panel lights with lenses and  
louvre accessories are covered in bulle-  
tin No. 36-10. A line of wall or mirror  
fixtures for lumiline lamps, also display  
case units and special wireway shapes  
for combinations of exposed lumiline  
and concealed cove effects are covered  
by bulletin No. 35-120. Garden City  
Plating & Mfg. Co., Chicago, Ill.

**Outlet boxes and Accessories:** Outlet  
boxes and covers, switch boxes and mis-  
cellaneous conduit fittings are covered  
in Bulletin No. 1021. Appleton Elec-  
tric Co., Chicago, Ill.

**Motor Parts:** An illustrated 96-page  
Catalogue No. 47 of repair parts for  
various makes of motors. Small shop  
tools; insulating specialties; special  
controller contacts, fingers and seg-  
ments, brushes, bearings, commutators  
and other miscellaneous service shop  
items are included. Reading Electric  
Co., Inc., New York, N. Y., and Chi-  
cago, Ill.

**Communication System:** A folder  
announcing the "Super Phone" system  
of inter-office, two-way telephones. The  
Holtzer-Cabot Electric Co., Boston,  
Mass.

**Fire Alarm System:** A 2-page folder  
describing Sprink-la-stats, automatic  
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Gamewell Co., Newton, Mass.

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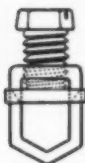
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■ Branch circuits are accessible thru the small door in the cover. Opening the cover disconnects the main service, exposing both the main and branch fuses

■ These two lines of entrance switches are acceptable wherever the meter-switch-fuse sequence is used and accessible main fuse switches are required. For further detailed information, write for Folder CA-540.

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